MONTHLY WEATHER REVIEW.

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The MONTHLY WEATHER REVIEW summarizes the current manuscript data received from about 3,500 land stations in the United States and about 1,250 ocean vessels; it also gives the general results of the study of daily weather maps based on telegrams or cablegrams from about 200 North American and 40 European, Asiatic, and oceanic stations.

The hearty interest shown by all observers and correspondents is gratefully recognized.

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As far as practicable the time of the seventy-fifth meridian is used in the text of the MONTHLY WEATHER REVIEW.

Barometric pressures, both at land stations and on ocean vessels, whether station pressures or sea-level pressures, are reduced, or assumed to be reduced, to standard gravity, as well as corrected for all instrumental peculiarities, so that they express pressure in the standard international system of measures, namely, by the height of an equivalent column of mercury at 32° Fahrenheit, under the standard force, i. e., apparent gravity at sea level and latitude 45°.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

The month opened with abnormally high barometric pressure over the British Isles and Iceland. The barometer was also above the normal over the Hawaiian Islands and northern portions of the United States. Attending this unusual distribution of atmospheric pressure, temperature was below the seasonal average generally over the interior of the United States and was above normal in the Plateau and Pacific States and on the Atlantic coast.

The first well-defined disturbance traversed the country from the 1st to 7th, preceded by temperature rising above the seasonal average, attended by local rains, and followed by a brief period of fair weather and moderate temperature. The following special forecasts regarding this warm period were issued:

THURSDAY, *July 2, 1908.*

The warm wave that now covers the extreme Western States will advance over the Plains States by Saturday, overspread the central valleys Sunday and Monday, and set in over the Atlantic States Monday and Tuesday.

SUNDAY, *July 5, 1908.*

A barometric depression that extends from Minnesota to Texas will drift slowly eastward during the next three days and cross the Atlantic seaboard about the middle of the week, preceded by warm, fair weather, attended by local rains, and followed by cooler, fair weather. The cooler area will reach the upper Mississippi Valley and the western Lake region Monday, will cover the Ohio Valley and eastern Lake region Tuesday, and reach the Atlantic coast Tuesday night or Wednesday.

The depression crost the Atlantic seaboard Wednesday, attended by local rains, and the cooler area advanced as indicated, overspreading the Atlantic coast States during Tuesday night and Wednesday. The passage of the depression was followed in the several districts by three days of cooler, fair weather.

On Thursday, July 9, the following special forecast was issued:

THURSDAY, *July 9, 1908.*

A warm wave that will cover the Plains States Friday will extend over the central valleys Saturday and set in over the Atlantic States Sunday. The warm period will be of two to three days duration in the several sections, and will end with rains in the Plains States on Sunday, in the Mississippi Valley and western Lake region Monday, and in the Ohio Valley, the eastern Lake region, and the Atlantic States Monday or Tuesday. The rains referred to promise to be sufficiently heavy to end the existing serious drought in the Ohio Valley and Middle Atlantic States.

The warm wave was the most intense of the present summer. Its progress and duration, and the movement of the rain and cooler area conformed to the forecast. In the Middle Atlantic States the warm wave set in Sunday and continued until Tuesday when it was broken by rains that were heavy in areas from the Ohio Valley over the Middle Atlantic and southern New England States.

On Wednesday, July 15, the following special forecast was issued:

WEDNESDAY, *July 15, 1908.*

A barometric depression that now covers the Rocky Mountain districts will move over the Plains States Thursday, cross the central valleys and Lake region Friday and Saturday, and reach the Atlantic States Saturday night or Sunday, preceded by rising temperature, attended by local rains and thunderstorms, and followed by two or three days of fair and cooler weather. This depression will cause rains in the wheat and corn belt and also rather copious rains in the Ohio Valley and the Middle Atlantic and New England States.

The depression advanced as forecast and generous rains fell in the corn and wheat region. Rainfalls were also heavy in areas in the Ohio Valley and in the Atlantic States north of Maryland and relieved the drought that prevailed in those sections. The depression was followed, in the interior of the country, by two or three days of temperature below the seasonal average. In the Middle Atlantic States the fall in temperature was slight.

The following forecast was issued on July 21:

TUESDAY, *July 21, 1908.*

Showers will set in over the Rocky Mountain regions Wednesday, and the rain area will advance over the Plains States Thursday, the central valleys Friday and Saturday, and reach the Atlantic States Sunday or Monday. Preceding the rain area temperature will rise in the several districts, and following its passage will come a period of cooler weather that will cross the country the latter half of the week and reach the Atlantic coast about the beginning of next week.

This forecast was verified as regards the eastward movement of rain and temperature areas. However, an extensive area of high barometer building up over the Atlantic Ocean from the 16th to 23d was joined on the 20th by a high area that had advanced over the Northern States and Canada, and combined with low pressure over the interior of the country to cause a drift of easterly winds from the Atlantic over the eastern portion of the United States. This resulted in several days of unsettled showery weather that began on the 21st and continued until the 27th.

In the meantime a shallow barometric depression advanced from the Caribbean Sea to the Gulf of Mexico from the 21st to 23d. Pressure continued low over the Gulf until the 25th when two centers of disturbance began to form, one over the west Gulf and the other near the east Florida coast. The west Gulf depression drifted slowly northward over the coast line without developing marked intensity. The disturbance near the Florida coast gradually deepened until the 29th, when a northward movement began and on the morning of the 30th a storm of marked intensity was central off the North Carolina coast. During the 30th the depression deepened rapidly and at 4:20 p. m. a reading of 29.18 inches was reported at Wilmington, N. C., and at the regular evening report of that date a reading of 29.22 inches was reported at that station. Storm advices had been sent to Atlantic ports for several days and storm warnings were displayed on the 30th from Wilmington, N. C., to Cape Cod. Based upon the 4:20 p. m. special report hurricane warnings were ordered from Hatteras to Norfolk. During the 31st the center of disturbance moved slowly northward and at the evening report had passed north of Hatteras where the barometer at the time of the regular evening observation read 29.32 inches. The subsequent course of this storm was northeast near the Middle Atlantic and New England coasts, and it disappeared over Newfoundland the night of August 2.

Concurrent with the passage of this storm along the Atlantic coast of the United States a destructive typhoon visited the China coast in the neighborhood of Hongkong and Canton.

The Jacksonville, Fla., Evening Metropolis, of July 30, 1908, comments as follows regarding this storm:

> The storm that the Weather Bureau has been watching for three or four days has at last shown itself, and this morning is approaching the coast line near Wilmington, N. C. At 7 a. m. the wind velocity at North Carolina stations was between 40 and 50 miles an hour from the east and northeast. No doubt the disturbance has given some sailing vessels a hard time. The fact that the storm has at no time been near land, and yet located daily with almost absolute accuracy, shows the exactness with which the Weather Bureau makes its predictions. There are a number of vessels that delayed sailing on account of the display of storm warnings, and they now appreciate the wisdom of their conduct. The Weather Bureau was established to render service. Who will say it is not doing so?

The month closed with moderate temperature from the central valleys over the Atlantic coast States, and exceptionally high temperatures in the northern Rocky Mountain districts, where maximum readings ranged above 100°.

BOSTON FORECAST DISTRICT.*
[New England.]

The drought that prevailed thru June continued during the first two weeks of July. During the latter half of July well-distributed showers occurred. Temperature ranged high, and in a number of instances maximum temperatures were the highest recorded in a number of years. Storm warnings were displayed on the 17th and 30th, and there were no storms without warnings.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.*
[Louisiana, Texas, Oklahoma, and Arkansas.]

Temperature was about or below normal and precipitation was unevenly distributed. But one storm, that of the 30th, appeared on the Gulf coast. Warnings that were justified were ordered for the Louisiana and Mississippi coasts on the morning of that date.—*I. M. Cline, District Forecaster.*

LOUISVILLE FORECAST DISTRICT.*
[Kentucky and Tennessee.]

Temperature averaged near the normal and precipitation was generally below the seasonal average. The longest warm period was from the 12th to 17th, and the longest cool period from the 8th to 11th. There were many thunderstorms, some of which caused local damage, and in Kentucky alone there were 10 or 12 casualties from lightning.—*F. J. Walz, District Forecaster.*

CHICAGO FORECAST DISTRICT.*
[Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, and Montana.]

No warnings were issued and none was required. Temperature was below normal during the first portion of the month, but a warm wave began during the third decade and the period closed with temperature abnormally high. Rainfall as a whole was deficient.—*H. B. Hersey, Inspector and District Forecaster.*

DENVER FORECAST DISTRICT.*
[Wyoming, Colorado, Utah, New Mexico, and Arizona.]

Heavy rainfall over an area extending from the Gulf of California to western Nebraska was a feature of the month. In northern portions of Utah and Wyoming the month was unusually dry. Temperature was below normal east and generally above normal west of the Continental Divide.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.†
[California and Nevada.]

Except at the close of the month when temperatures exceeded 110° in the interior of the State the month as a whole was cool in California. There were many thunderstorms in the mountains. Light showers fell at the beginning of the second decade and from the 10th to 14th showers occurred in Nevada and the Sierra. There were no storm nor frost warnings issued.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.†
[Oregon, Washington, and Idaho.]

The month was quiet with temperature above and rainfall generally below normal. Periods of high temperature extended from the 6th to 12th, 18th to 22d, and 29th to 31st, the last-named date showing very high temperatures over the eastern portion of the district. No special warnings were issued and none was needed.—*E. A. Beals, District Forecaster.*

RIVERS AND FLOODS.

The lower Mississippi River floods of the spring and early summer of the year 1908 were especially remarkable for their extreme duration. They may be said to have begun when the Ohio River flood of February reached New Madrid, Mo., on the 21st of that month. From this time until July 24 either the entire lower river, or some portion thereof, was above the flood stage. The flood stage of 16 feet was first past at New Orleans on March 9, and the river did not again fall to that stage until July 25, a period of 138 days. The following table shows the number of days the lower Mississippi River was at or above flood stage from New Madrid to New Orleans. Comparative figures for the great flood of 1903 are also shown.

These lower Mississippi floods were also remarkable for the fact that for the first time in more than a generation the western tributaries played an important part. As a rule, unless the Ohio River is very active, the floods below Cairo, Ill., are neither prolonged nor dangerous, but during the present year, with the Ohio only moderately active, the floods were of unprecedented duration, altho not so great in volume as those

* Morning forecasts made at district center; night forecasts made at Washington, D. C.

† Morning and night forecasts made at district center.

of 1897 and 1903. The Ohio River was, of course, a prominent factor, as the floods of February, March, and April in that river, while not unusual, kept the waters of the lower Mississippi at a comparatively high stage, and rendered them more readily responsive to the influence of the western and northern tributaries. Later on the volume was swelled by the May floods of the Arkansas and Red rivers, and again in June by another flood from the same rivers, to which were joined the flood waters from the Missouri and upper Mississippi rivers. Had the Ohio River been in flood in June, a not altogether unprecedented occurrence, the lower Mississippi flood would have been the greatest in its recorded history.

Station.	Flood stage.	Number of days at or above flood stage.	
		1908.	1903.
	Feet.		
New Madrid, Mo	34	50	53
Memphis, Tenn	33	59	54
Helena, Ark	42	66	67
Arkansas City, Ark	42	132	82
Greenville, Miss	42	66	39
Vicksburg, Miss	45	115	60
Natchez, Miss	46	104	.....
Baton Rouge, La	35	111	.....
Donaldsonville, La	28	107	.....
New Orleans, La	16	138	85

Following are the detailed reports by the officials in charge of the river districts of Memphis, Vicksburg, and New Orleans.

MISSISSIPPI RIVER FROM CAIRO, ILL., TO HELENA, ARK.

By S. C. EMERY, Official in charge, Local office of the Weather Bureau, Memphis, Tenn.

While no serious floods have occurred from Cairo to Helena during the present season, the river conditions have been very remarkable.

In January a moderate rise kept the river above a normal stage during the greater portion of that month, and from about February 20 to the second week in June, it was above a 30-foot stage at Memphis, except from April 30 to May 10, when it was from one to two feet below. During this time four great rises came into the lower river, each of which carried the water slightly above 35 feet at Memphis and from 44 to 45 feet at Helena. At Memphis the water stood at or above flood stage (33 feet) on fifty-nine days. The greatest number of days with the river above flood stage in any previous year was sixty-five in 1882, while in the great floods of 1897 and 1903 the record was fifty-two and fifty-four days, respectively. At Helena, Ark., it was above flood stage (42 feet) on sixty-six days, which is only one day less than the record for 1903. At New Madrid, Mo., it was above flood stage (34 feet) on fifty days, which is only three days less than the record for 1903. The highest stage at New Madrid during any of the four rises was 36.6 feet on March 20, and the river was above 36 feet on nineteen days. At Memphis the highest stage was 35.6 feet on March 23, and the river was at or above 35 feet on twenty days. At Helena the highest stage was 45.2 feet March 26 and the river remained above 44 feet on thirty days.

From February 25 to June 1 the low, unprotected lands along the river were never sufficiently free from water to permit farming operations to be carried on except to a limited extent, and levee work was entirely suspended for nearly four months.

The first rise reached the head of the district on February 13, giving New Madrid a stage of 36.2 feet on February 28, Memphis 35.1 feet on March 3, and Helena 44.2 feet on March 5. The water then fell slowly for about five days, but had hardly fallen below flood stage at Memphis and Helena, when the second rise came on sending the river to higher stages than had the previous one. At New Madrid it reached 36.6 feet on March 20, Memphis 35.6 feet on March 23, and Helena 45.2 feet on March 26. These two rises came mainly from the Ohio watershed and it is interesting to note that the movement of flood crests from Pittsburg to Helena occupied exactly eighteen days in both cases. The time interval to Cairo was ten, to Memphis fifteen, and to Helena eighteen days. Timely warnings were issued for these rises and estimates as to the maximum height of the flood were given out from six to nine days in advance. On the first rise the errors in the estimates given out were in no case greater than 0.2 foot. On the second rise there was an error of 0.4 foot at New Madrid and Memphis, while an accurate estimate was given for Helena fourteen days in advance of the arrival of the crest.

The third great rise set in at the head of the district about April 10, with the water still close to flood stage over the whole course from Cairo to Helena and considerably above flood stage at all points below. This rise gave New Madrid a stage of 36.2 feet on April 15, Memphis 35.2 feet on April 20, and Helena 44.6 feet on April 22. The crest of this rise moved from Cairo to Helena in eight days, thus making the same time as the two preceding.

The fourth rise came on very slowly and was caused mainly by heavy downpours of rain over Illinois, Indiana, and the region drained by the small tributaries that empty into the Mississippi River between Cairo and Memphis. The river rose so slowly that the crest did not reach Memphis until twenty days after the river began to rise at New Madrid. The maximum stage at New Madrid was 36.1 feet on May 21, at Memphis it was 35.3 feet on May 25, and at Helena 44.4 feet on May 27. Exact estimates on the height of the flood at Memphis and Helena were made seven days in advance of the arrival of these crests. Owing to reports of severe floods in the upper tributaries, considerable alarm was felt in some portions of the district in regard to their possible effect on the lower river, and the demands made on this office were at times very great. To satisfy these demands and to allay as much as possible the unnecessary alarm caused by sensational reports, river bulletins giving the exact conditions at the time, and what might be expected in the future, were extensively distributed each day thruout the district with very good results.

The heavy and long-continued rains thruout the lower Missouri watershed during June, caused severe floods in the Mississippi River from near St. Louis to Cairo, and these floods, together with the congested condition of the lower portion of the river, prevented any material decline in the Mississippi from Cairo to Helena during the entire month of June. From the 1st to the 25th, the fall only amounted to about $1\frac{1}{2}$ feet, the stage on the latter date being practically 29 feet.

The records of this station, which extended back to 1872, show only five June rises of equal proportion to the one experienced in this district in 1908. The years with June stages higher than those of the current year were 1872, 1892, 1893, and 1903, and the stages were as follows:

Table of June stages.

Year.	Feet.
1872	31.6
1883	30.2
1892	34.4
1893	33.5
1903	33.0
1908	30.7

In 1873 the river was very high in June, but not so high as in the present year.

As the crest stages of the present season were about five feet below the extreme high-water mark, the levees afforded ample protection to the St. Francis and Reelfoot basins into which very little water escaped. The levees were at no time considered in danger of breaking, tho there were one or two places where bank erosion caused some anxiety on account of the close proximity of the levee to the river. The farming interests outside of the levee on the Arkansas side of the river

and on the lowlands and islands on the Tennessee side suffered great loss on account of the delay in planting, and the people occupying those lands were put to the expense and inconvenience of taking up a temporary residence elsewhere until the water subsided. In many places planting was entirely discontinued for the season and in the lower portion of the district a considerable area of tillable land was submerged until near the end of June.

The money losses due to the high water were about $800,000, and they would have been larger had it not been for the warnings and bulletins issued by the Weather Bureau. These warnings enabled the farmers to move stock and other portable property to places of safety before it was too late. They also saved many the expense and trouble of moving when such action was not necessary. Farmers were also benefited in being saved the expense of replanting after the receding of the water following the several rises, for without the knowledge obtained thru the Weather Bureau, the work of planting would have gone on, only to have the land again covered and the crop ruined by the next succeeding rise.

Engineers and contractors engaged in levee work kept constantly in touch with the Bureau and in this way were saved the expense of prematurely moving their several camps to the low ground.

MISSISSIPPI RIVER FROM HELENA, ARK., TO VICKSBURG, MISS. YAZOO RIVER.

By W. S. BELDEN, Official in charge, Local office of the Weather Bureau, Vicksburg, Miss.

In point of duration the flood that began in the lower Mississippi River in the first decade of February was the most remarkable on record. The flood was due principally to four rises out of the Ohio River and four distinct rises out of the Arkansas River. The rises that came out of the Ohio culminated at Cairo, Ill., February 26, March 18 and 19, April 13 and 14, and May 20, with crest stages between 44.9 and 45.5 feet in each case. The first rise out of the Arkansas crested at Little Rock, Ark., April 15 and 16 with a stage of 23.3 feet; the second reached a stage of 21.0 feet April 27; the third 22.3 feet May 16, and the fourth, which furnished a volume of water much greater than the first three combined, kept the water near or above 25 feet on the Little Rock gage from May 28 to June 22.

At Arkansas City, Ark., in the upper portion of this district, the Mississippi River was continuously above flood stage for one hundred and thirty-two days, and at Vicksburg, in the lower portion of the district, the river was at or above flood stage for one hundred and fourteen days. The following table of river data for Vicksburg shows clearly the unprecedented flood conditions of this year:

TABLE 2.—*Floods of long duration at Vicksburg, Miss.*

Year.	Highest stage.	Month.	Period continuously above flood stage, 45 feet.	Last date above flood stage.
	Feet.		*Days.*	
1874	45.7	May	23	May 15.
1882	48.8	March	37	April 15.
1884	49.0	March	78	May 18.
1890	49.1	April	94	May 19.
1891	48.1	April	64	May 9.
1892	48.4	May	73	July 5.
1893	48.3	May	44	May 20.
1897	52.5	April	70	May 29.
1898	49.4	April	26	May 5.
1899	47.3	April	31	May 2.
1903	51.8	March	58	April 30.
1904	46.9	April	17	May 2.
1906	47.2	April	19	May 5.
1907	49.7	February	32	May 31.
1908	47.9	June	114	July 3.

In 1907 the water was above flood stage for a total of 43 days, due to three distinct rises. In other years the total number of days with the water above flood stage is the same as the number of days with water continuously above flood stage.

From the table it will be noted that the river was continuously above flood stage longer than ever before, and that in only one other year, namely 1892, was the water above flood stage later than May 31.

Approximately 500 copies of the river bulletin were issued daily thruout the flood period, being distributed by steamboat captains to planters up and down the river and by mail to nearly all post-offices in this district. The daily bulletin was also telephoned or telegraphed regularly to Greenville and Natchez and to several smaller places, where it was posted for the benefit of the public.

The first flood warning was issued February 20, stating that the flood stage would be exceeded at Arkansas City in about a week. On February 27 the stage at Arkansas City was 42.5 feet, or 0.5 foot above flood stage. On March 2 flood stage was forecast to be reached at Vicksburg by March 13, and on March 12 and 13 the river was 0.1 foot above flood stage. On March 18 the following forecast was issued:

> The crest of the rise now nearing Cairo will reach Arkansas City in about 10 days, with a stage of 48.5 feet. At Greenville, Miss., a crest stage of 42.5 feet is expected, and at Vicksburg the maximum stage will be close to 46.5 feet.

On March 28 Arkansas City reported 48.2 feet, Greenville 42.5 feet, and Vicksburg 46.6 feet. During the first two weeks in April the water receded very slowly from Helena to below Vicksburg.

The water continued to recede slowly below Helena for two weeks subsequent to May 1, but by May 19 the river was again rising thruout the district as the result of the last swell out of the Ohio which set in at Cairo May 5. The last and most phenomenal rise out of the Arkansas was first registered on the Fort Smith, Ark., gage May 24, and on the Little Rock gage two days later. This rise in conjunction with the already long-continued flood on the lower Mississippi produced a very serious condition below the mouth of the Arkansas River. The river bulletin of May 27 contained this forecast:

> As the result of the rise coming out of the Arkansas, a stage of slightly more than 50 feet is now indicated at Arkansas City by June 2, close to 45 feet at Greenville a day later, and about 48 feet at Vicksburg June 7.

The crest stages of the season, with dates of occurrence, were as follows: Arkansas City, 49.9 feet, or 7.9 feet above flood stage, June 2 to 4; Greenville, 44.7 feet, or 2.7 feet above flood stage, June 4 and 5; and Vicksburg, 47.9 feet, or 2.9 feet above flood stage, June 6 to 10, inclusive. Subsequent to the crest stages the water fell very slowly, the fall amounting to only 1.9 feet in twenty days at Vicksburg, or less than 0.1 foot per day.

On June 27 it was predicted that the water would pass below flood stage at Vicksburg by July 5. Flood stage still obtained July 4, after which the rate of fall increased steadily.

The upper Yazoo River was high in February and March, and the water was above flood stage at Swan Lake, Miss., from February 19 to March 16, the crest stage of 27.4 feet, or 3.4 feet above flood stage, occurring on February 29. At Greenwood, Miss., flood stage was not reached by several feet. Back water in the lower Yazoo Valley was an important factor in producing the high stages at Yazoo City, Miss., where the rise was very slow from February 17 to March 22. Heavy rains in the vicinity of Yazoo City from March 22 to 24 caused a rise of 1.5 feet in two days, and to 26.0 feet, or 1.0 foot above flood stage, March 24, after which the river fell very slowly, passing below flood stage April 9. However, the water continued above 21 feet on the Yazoo City gage until June 30.

The immense levees on both sides of the Mississippi River from Helena southward, effectively protected hundreds of thousands of acres of very rich agricultural lands. At many places the water stood from 10 to 15 feet against the embankments for months, while planters and tenants were busily

engaged in seeding and tending their crops. There was considerable damage to growing crops from seepage water, especially on Davis Island, which is protected by a private levee; but as a rule the seepage water did not extend far inland from the State and Federal levees, and its detrimental effects can probably be overcome to a large extent, in future floods, by drainage systems to swamps and bayous. There has been no material change in the levees since the flood of last year, and during the recent flood wave-wash was somewhat damaging to those on the Mississippi side of the river. The amount of cultivated land lying between the river and the levees from Helena to about 25 miles above Vicksburg is relatively small, hence losses caused by the flood were comparatively light in that stretch of the river, but the back water in the lower Yazoo Valley proved to be very disastrous. Tillable lands were overflowed for a distance of 50 miles up the Yazoo Valley, and many large plantations in Issaquena, Warren, and Claiborne counties were covered with water until the latter part of June. The lateness of the flood was its most damaging feature. When the water receded the season was too late to permit of bringing a crop of cotton to maturity, and fully 35,000 acres of farm lands in the Yazoo Valley and contiguous to Vicksburg were thus affected.

It became necessary to move nearly 1,000 head of horses, mules, and cattle from the overflowed districts near Vicksburg, but no stock was reported drowned as the warnings of the Bureau were closely heeded. The warnings were also the direct means of saving not less than $8,000 worth of cotton seed that would otherwise have been planted and subsequently ruined by overflow. Fences and buildings in the overflowed area were more or less damaged, but the stage of the water was not sufficiently high to cause material injury by erosion. In many cases lands were greatly enriched by deposits of sediment. Back water caused an entire suspension of traffic on the Yazoo and Mississippi Valley Railroad between Kelso and Holly Bluff, Miss., a distance of 13 miles, from about March 1 to August 1, some time being required to repair the roadbed subsequent to the subsidence of the flood.

Very few of the negro tenants moved from the overflowed plantations since the houses and cabins are raised four or five feet above the ground, but the enforced idleness placed nearly all in straightened circumstances at the end of the long siege. The Federal Government, thru the War Department, issued 10-day rations on July 4 to 4,473 persons in Issaquena, Warren, and Claiborne counties at a cost of $2,869.31, and again on July 17 rations for thirty days were issued to 5,600 persons in the same territory at a cost of $17,332. It was expected that gardens and some late crops would in a measure meet the needs of those tenants that could not otherwise provide for themselves when the rations were consumed.

Losses resulting from the flood in this district were as follows:

Losses from floods in Vicksburg–Yazoo River district, 1908.

Property (exclusive of crops) destroyed	$75,000
Crops	250,000
Damage to soil by erosion and deposition	None.
Suspended business (including wages)	1,500,000
Total losses	1,825,000
Property saved by flood warnings	35,000

That so small an amount of property was saved thru the Weather Bureau warnings was not due to any defects in the warnings themselves, but rather to the effectiveness of the levee system. In previous years the levees were not so complete and extensive as they now are, and the warnings of the Weather Bureau usually found property of great value that must either be removed or lost.

MISSISSIPPI RIVER FROM VICKSBURG, MISS., TO MOUTH. ATCHAFALAYA RIVER.

By I. M. CLINE, Official in charge, Local office of the Weather Bureau, New Orleans, La.

The flood in the lower Mississippi and Atchafalaya rivers, which commenced in February, and reached its maximum June 19 and 22, 1908, exceeded all previous records for duration of high water. The Mississippi reached a stage of 20 feet at New Orleans, which was within 0.4 foot of the high-water record of April 6–7, 1903. A stage of 39.7 feet was reached at Melville, on the Atchafalaya, which was 1.5 feet above the previous high water record.

On February 24, 1908, the stage of the Mississippi at New Orleans was 13.3 feet, and the following warning was issued:

The Mississippi River, below Vicksburg, and the Atchafalaya, will rise; a flood stage of 16 feet will be reached at New Orleans, and 34 feet at Simmesport and Melville by March 4.

The water rose steadily and reached the stages forecast, as follows: Simmesport, 34 feet, March 2; Melville, 34 feet, March 7; New Orleans, 16 feet, March 9. Warnings were then issued regularly until the end of March, advising the public, ten days in advance, as to what stages to expect. Warnings were issued March 30 for the passage of the crest of the high water then in sight, with stages of 46.6 feet at Natchez by March 31; 35 feet at Baton Rogue, 39.5 feet at Simmesport, 37 feet at Melville by April 4, and 17.9 feet at New Orleans by April 5. The crest past with stages as follows: Natchez, 46.9 feet, April 3; Baton Rouge, 35.3 feet, April 4; Simmesport, 40.3 feet, April 9 (with a stage of 39.8 feet, April 4), and Melville, 36.9 feet, April 8 (with a stage of 36.8 feet, April 4). The Mississippi and Atchafalaya rivers then remained nearly stationary until the middle of April. On April 16 the following warning was issued:

A fresh rise, now coming down the Mississippi River, will prolong the high water below Vicksburg for two or three weeks, and is likely to cause a further rise at New Orleans to about 18.5 feet, and, should high southeast winds occur, a still further rise would result.

A stage of 18.5 feet was reached at New Orleans on May 1, and southeast winds backed the water up to 19.1 feet, May 6, after which the river remained high, with a slight fall until May 20, when the gage at New Orleans showed 18.6 feet. On May 20 the following warning was issued:

As a result of rises now coming, the Mississippi, below Vicksburg, and the Atchafalaya will continue high until the middle of June, and, if levees hold, stages are indicated as follows: Natchez, 48 to 48.5 feet; Baton Rouge, 38.5 to 39 feet; Simmesport, 45.5 feet; Melville 40 feet; and should brisk southerly winds prevail during the passage of the crest, a stage of 19.5 to 20 feet may be reached at New Orleans.

The following stages were reached: Natchez, 48.9 feet, June 14; Baton Rouge, 39.6 feet, June 16; Simmesport, 45.2 feet, June 19; Melville, 39.7 feet, June 23; and New Orleans, 20 feet, June 19 and 22. With the exception of a few days, the water stood above 18 feet on the gage at the foot of Canal street, New Orleans, from April 6 to July 15, covering a period of one hundred days.

The levees of the Mississippi and Atchafalaya rivers had been raised and materially strengthened since the high water of 1903. There were, however, some weak places, and there were places subjected to unusual strain during high water, all of which were strengthened as a result of the warnings of the Weather Bureau.

They withstood the remarkable strain of more than three months of continuous high water without a break, except below New Orleans. The successful carrying of this vast volume of water without more breaks in the levees may be attributed partly to the warnings of the Weather Bureau, which kept the public on the alert, raising and strengthening the levees wherever weak spots were found to exist.

The first break in the levees of the Mississippi occurred in the right bank of the river, on the Beka Plantation, 14 miles below New Orleans, early on the morning of June 6. The break was discovered about 7:30 a. m., when only a few feet in width. The banks crumbled rapidly and, notwithstanding the fact that two hundred workmen were assembled and put

to work with the greatest possible dispatch, the crevasse was 35 feet wide at 7 p. m., at which time it was believed that its spread had been checked. Cribbing was put in around the crevasse, but the bank continued to give way, and on June 8 the opening was 75 feet in width. The water by this time had covered the Rio, the Beka, and the Stanton plantations, almost totally damaging the crops growing thereon, aggregating about 30,000 tons of cane. On the night of June 9 the cribbing, which had been constructed across the crevasse, was swept away, and on June 10 the break was reported to be from 90 to 100 feet in width. On June 12 four hundred men were at work building cribbing and endeavoring to close the crevasse. The work was carried forward vigorously under the direction of the State board of engineers, and the crevasse was successfully closed June 26, just twenty days after the break occurred. On June 15 a small break in the levee, less than two feet in width, was discovered on the right bank of the Mississippi, about eight miles below New Orleans. Workmen, with material from the crevasse six miles farther down the river, were rushed to the scene, a mud-box forty feet in length was constructed, and the break was closed.

South of Vicksburg all bottom lands not protected by levees (known as "batture lands") were flooded and crops damaged.

The damage caused by high water in the Mississippi and Atchafalaya rivers may be summarized as follows:

(1) The destruction of 100 feet of levees on the Mississippi River below New Orleans.

(2) The destruction of sugar-cane crops below New Orleans which it is estimated would have produced 30,000 tons of cane. The destruction of cotton crops on the "batture lands" south of Vicksburg which ordinarily produce 20,000 bales of cotton.

(3) No reports of damage to farm lands by erosion or deposit have been received.

(4) Business was suspended for about four weeks on three plantations below New Orleans, but the laborers from these plantations were employed in repairing the breaks in the levee. Laborers from the "batture lands" were used elsewhere.

THE ARKANSAS AND RED RIVER FLOODS.

As stated in the MONTHLY WEATHER REVIEW for May, 1908, the heavy rains from the 22d to the 24th, inclusive, of that month, were responsible for the great floods in the lower Arkansas and the Red rivers. These heavy rains were followed by others during the first ten days of June; the fall in the two rivers, which were still above flood stage, was checked, and another rise was started that finally culminated about the middle of the month in the highest stages of the season.

The floods in the Arkansas River and tributaries above Fort Smith, Ark., were not nearly so pronounced as during May, and the losses were only about $45,000, mainly thru enforced suspension of business. Warnings were issued whenever possible, and one on June 3 for the Arkansas River was particularly effective.

The lower Arkansas flood was one of the longest and most destructive on record. There were three distinct swells, each lasting from four to six days, beginning on May 25, June 4 and 13, respectively. At Dardanelle, Ark., the river was above the flood stage continuously for twenty-six days, and at Little Rock, Ark., for twenty-seven days. Warnings were issued frequently and they were well verified. There was no loss of life and very little of live stock, as the warnings enabled the farmers to take all necessary precautions. The crop losses were heavy. About 40,000 acres of cotton lands were overflowed, and the losses in cotton alone amounted to about $2,000,000. Much of the damage occurred thru the breaking of levees. The White River was also in flood for several days.

From any viewpoint the flood in the Red River was beyond all precedent. Nothing in the recorded history of the valley can compare with it in point of duration, high stages, extent of overflow, and amount of damage. The flood stage was first reached at Denison, Tex., on May 25, and from that time until nearly the end of July either all, or some portion, of the river was above the flood stage. At Denison the highest stage was 32.5 feet on May 26, 10.5 feet above the flood stage and 8.9 feet above the highest previous stage of record. At Arthur City, Tex,, the highest stage was 43.2 feet, on May 28, 16.2 feet above the flood stage and 6.2 feet above the high-water mark of May 10, 1890. At Fulton, Ark., and Shreveport, La., record-breaking stages were prevented by the breaking of the levees above Fulton. Below Shreveport all previous records were exceeded.

Particular attention is invited to the warnings issued by the Weather Bureau for this flood. They were begun well in advance, and were so specific and decisive in their character as to leave no room for doubt or hesitancy on the part of those interested. Thousands of lives and many millions of dollars worth of property were in imminent danger, and there was no time for delay. No lives were lost, but the property losses were enormous, and they would have been much greater had the warnings failed in any respect.

The money value of the losses and damage along Red River were about $16,200,000, divided as follows:

Property, excluding crops	$3,600,000
Crops	8,500,000
Erosion of lands (in excess of benefits)	1,600,000
Suspension of business, etc	2,500,000
Total	16,200,000

FLOODS IN THE RED RIVER AT AND ABOVE SHREVEPORT, LA.

By J. W. CRONK, Official in charge, Local office of the Weather Bureau, Shreveport, La.

In several parts of the Red River Valley this was the most disastrous flood on record. Only by persistent and exhausting labor expended in repairing and raising levees was it possible to save any part of the valley in this section from an overflow.

In the Texas and Arkansas sections, southward from Denison, Tex., all levees were broken, and practically all crops were destroyed, and there was also great damage to bridges, buildings, railroads, and other property.

In Louisiana, by very hard work, the State levees to the north of Shreveport were held intact, thereby saving some 200 square miles from overflow.

Below Shreveport the State levees were broken at three places—at Taylortown, La., on the east bank, and at the "Dixie" and "Riverdale" plantations, on the west bank of the river. As the result of these three breaks several railroads were heavily damaged, and the crops were completely destroyed on notably rich farm lands over an area of 200 or more square miles.

Altho the flood losses were more or less heavy in all parts of the valley, there is no doubt that they would have been far greater had it not been for the warnings of the Weather Bureau. These warnings were early and urgent, and it is especially gratifying to note that there was no loss of life, altho a large number of dwellings were either flooded or washt away. Losses in stock were small, and these losses were mainly due to gross neglect of the warnings. On each and every day of the flood the Weather Bureau was in close touch with the people in all parts of the valley, and many thousands of specific questions, involving the protection of property, were satisfactorily answered. Besides the general saving of live stock, there was a large quantity of other property in the flooded districts, such as farm implements, furniture, foodstuffs, etc., that it was possible to save. In many instances dwellings and other structures, including bridges, were weighted with iron and stone or other heavy material, and their loss thereby prevented.

Many of the working class in this valley are in a destitute condition, as a result of the flood, and the Government and

the people expended more than $100,000 to relieve the situation by the purchase of food and of seed for food crops.

The widely extended heavy rainfall of May 23 and 24 over the watershed above Arthur City was the principal cause for the main part of the flood. Comparatively little rainfall was reported at that time in eastern Oklahoma and Arkansas, where the floods of the Red River usually originate, but heavy rains from May 11 to 14, over the entire watershed, had previously caused a flood of noticeable proportions in the vicinity of Fulton and more or less high water at other points, so that the Red River was already full over a considerable part of its length before the flood waters from above Arthur City had been added. Heavy rains at various other times during the last of May and the first half of June also added a large volume of water to the river, thereby prolonging or increasing the flood at many places.

Owing to the wide extent of the flood it was necessary to issue an unusually large number of flood warnings.

The first warning on May 24, Sunday, gave notice of the "coming of unusually high flood stages" at Denison and Arthur City, the river to rise more than 11 feet, or above the flood stage of 27 feet, at Arthur City on Monday, and to continue to rise for several days. The special caution was added that "extra efforts should be immediately made to remove the people and stock from all unsafe places in the upper valley."

The cooperation of the press in the dissemination of this and other warnings was of especial benefit.

As early as May 25 a flood warning for a stage of 32 feet and over at Fulton was thoroly disseminated. Three days later the public was warned that "no preparations should be neglected to prevent loss of life in Arkansas from any possible sudden rises to unknown stages." Three days later another warning was issued for a crest stage somewhat above 36 feet at Fulton, but this stage was not reached, as a very large volume of water broke thru embankments just above Fulton, swept across the country by a shorter channel, and reached the Red River again at points below Fulton. Reliable reports state that the highest known flood stages were recorded during this flood within about 4 miles of Fulton, that is, above the broken embankments. It was in this section that the Iron Mountain Railway suffered a heavy loss, several miles of roadbed being washed away.

The crest stages of the flood at the river stations of the Weather Bureau were as follows:

TABLE 3.—*Crest stages of flood on Red River.*

Stations.	Flood stage.	Crest stage.	Date.	Above flood stage.
	Feet.	*Feet.*		*Days.*
Denison, Tex.	22	35.5	May 26	3
Arthur City, Tex	27	43.2	May 28	19
Whitecliffs, Ark	20	29.0	May 16	42
Fulton, Ark.	28	34.1	June 2	45
Shreveport, La	29	35.2	June 15	26

Careful estimates of losses due to the floods this year in the Red River appear below:

Losses by flood on Red River above Shreveport, La.

Property loss (excluding crops)	$3,000,000
Value of crops destroyed	6,000,000
Damage to lands (in excess of benefits)	1,500,000
Suspension of business	2,500,000
Total	13,000,000
Value of property saved by Weather Bureau warnings	4,500,000

THE FLOOD BELOW SHREVEPORT, LA.

By I. M. CLINE, Official in charge, Local office of the Weather Bureau, New Orleans, La.

The Red River below Shreveport reached a stage of 30 feet at Alexandria, La., toward the latter part of April. During the early part of May the river either rose slightly or remained about stationary. Warnings were issued May 20 for a 36-foot stage at Alexandria by June 1. This stage was reached May 29, and the public was then advised to prepare for a stage of 38.5 feet at Alexandria by June 8. On June 9 warnings were issued for a stage of 38.5 to 39 feet by June 19. A stage of 38.9 feet was recorded June 18 and on June 20 warnings were issued for a stage of 39 to 39.5 feet by June 23. A stage of 39.6 feet was recorded on June 23, and the public was advised to prepare for a stage of 40 to 40.2 feet within three days. From this date until the passage of the crest of the high water warnings were issued two to three days in advance, advising as to what stages might be expected, and on July 3 warnings for a stage of 42.2 feet at Alexandria by July 6 were issued, this being the last warning issued for rising water.

The highest stage recorded was 41.8 feet on July 6, which was 3.6 feet above the previous high-water record. The flood warnings were based, in a measure, on the levees holding, and in some instances the stages reached were 0.2 to 0.4 of a foot below the stages forecast, as a result of water flowing out thru breaks in the levees and being carried away thru other channels.

Several breaks occurred in the levees along the Red River. One occurred near Westdale, De Soto Parish, La., June 9, flooding a large area. There was also a break in the vicinity of Creighton, La., June 12, which overflowed a large area of land and caused other damage. About 3 a. m., June 14, two breaks occurred in the levee on the left bank near Moncla, Avoyelles Parish, La., and much land was overflowed. There was a break in the left bank at Tarrytown, 14 miles below Shreveport, in Bossier Parish, at 3 a. m., June 15, which flooded 100,000 acres of land. Hundreds of people were rendered homeless and it was stated that the damage could not be estimated. Another break in the levees occurred below Shreveport, in Caddo Parish, about 6 p. m., June 16, and several plantations were flooded. Estimates placed the flooded area at 250,000 acres. On June 18, about 1 a. m., a break occurred in the levee near Alexandria, on the plantation of Major Fred Seip. The water from this crevasse overflowed more than 4,000 acres of land and rendered one hundred families homeless. On June 25 a break occurred seven miles above Alexandria and a considerable area was flooded. A large volume of water was flowing thru crevasses on the Johnson and Cooper places above Alexandria July 6, at which time the stage at Alexandria was 41.8 feet. Had it not been for the crevasses the stage of 42.2 feet forecast for Alexandria would no doubt have been reached.

In looking for an explanation as to the causes of the unprecedented high water at Alexandria it appears that the volume of water which came down the Red River was not of itself sufficient to have caused the stage reached. The Mississippi and Atchafalaya rivers, into which the Red River discharges, were high and back water from the floods in these streams caused a very slow discharge of the flood waters from the Red River and their consequent congestion for some distance up the Red River. This effect was noted at Alexandria in the early stages of the flood.

The damage caused by overflows along the Red River was very great. The losses amounted to several millions of dollars, which may be summarized in general terms as follows:

(1) The destruction of levees in several localities. Buildings, household effects, and live stock of considerable money value were washt away, and a great number of people were rendered homeless. Railroads near the Red River suffered much damage. Several miles of track were inundated, roadbeds were washed out in places, and traffic had to be suspended or changed to longer routes. The railroads in Louisiana probably suffered to the extent of more than half a million dollars.

(2) The bottom lands along the Red River, planted to cotton

and corn, were overflowed to a great extent and the growing crops destroyed.

(3) Many thousand acres of land suffered to some extent from erosion or deposit.

(4) Several hundred laborers were thrown out of employment, but many of these secured employment after a few weeks in other parts of the State where available labor was not sufficient to meet current demands. The loss from the suspension of business was quite heavy.

(5) Regarding the value of the warnings of the Weather Bureau, it is impossible to express the same in money terms. As a result of the warnings the levees were raised and strengthened, and the public had time to transfer movable property to places of safety. The fact that, with unprecedented high water, there was no loss of life as a direct result of the overflows may be largely attributed to the flood warnings of the Weather Bureau which advised the people of the coming of the high water.

The floods in the upper Missouri Valley were caused by the heavy rains in the early days of the month of June, 1908, and before they subsided the highest stages on record occurred in the Missouri River and its northern tributaries as far east as the Montana-North Dakota line. Great damage was done, and in some sections of central Montana railway traffic was suspended for more than three weeks.

FLOODS IN THE UPPER MISSOURI RIVER.

By C. D. REED, Official in charge, Local office of the Weather Bureau, Sioux City, Iowa.

Heavy rains occurred in Montana during the first week in June and there was a general downpour on the 4th and 5th, which caused most of the smaller streams to swell to stages before unknown, thereby damaging irrigation ditches and plants, eroding the soil, drowning live stock, and paralyzing railway and telegraph service. Destructive floods occurred in Missoula, Gallatin, Madison, Park, Meagher, and Rosebud counties.

By the 6th and 7th the water had collected and begun to do damage at points along the larger streams, particularly the Missouri and Milk rivers. For a long distance above and below Fort Benton, Mont., on the Missouri River, the tracks of the Great Northern Railway were under 9 feet or more of water, and in many places the grade was washt away, together with the telegraph poles and wires. At Fort Benton a stage of 18 feet was reached between the morning of the 6th and the morning of 7th. Nearly the entire town was overflowed and boats were used in the streets. The oldest inhabitants could not remember having heard of such high water. The highest stage heretofore recorded was 11 feet on June 14, 1892. Twelve miles below Fort Benton, where the Teton and Marias rivers flow into the Missouri, the water was reported to be 32 feet above low-water mark and a clean sweep was made of everything, including livestock, while the people themselves barely escaped to the hills.

On this section of the Missouri River the following very conservative estimate of the damage has been made:

Property destroyed (excluding crops)	$150,000
Crops destroyed	40,000
Damage to farm land	100,000
Enforced suspension of business	20,000
Total	$310,000

The Milk River at Havre rose steadily until it reached a stage of 16.3 feet on the 9th, which is higher by 1.3 feet than the previous high water of April, 1899. The flood stage of 9 feet has reference to interests nearby, but not in the town, which is protected from flood by a railway grade, so that a stage of 20 feet could be reached before damage would begin. For a short distance above, and for 25 miles below the town, the damage by the deposit of mud was great and it is thought that a number of years will be required to restore the soil to its normal condition. This land is used chiefly for hay, but some other crops are raised. Railway train service between Havre and Helena was not resumed for twenty-six days after June 4, mainly on account of high water along the Missouri. The interference with telegraph service in the incipient stages of these floods made it impossible to distribute warnings anywhere in the State of Montana.

The crest of the flood in the Missouri River flattened rapidly as it past eastward, but it was at the same time augumented by continuous rains in eastern Montana and the Dakotas, so that the crest appeared to move much slower than usual. From Fort Benton to Wolf Point, Mont., is usually not more than five days' run for flood crests, but in this case the highest water at Wolf Point occurred seven days later than at Fort Benton. The highest water at Wolf Point was 12.8 feet on the 14th, which was 0.7 foot higher than any previously recorded stage. From Wolf Point to Bismarck, N. Dak., is usually not more than two or three days' run for a flood crest, but the highest water at Bismarck in this instance was not reached until the 19th, five days later than at Wolf Point. This was due to further augmentation by heavy rains mainly within the confines of North Dakota. The highest stage, 15.1 feet at Bismarck, was 0.4 foot higher than any previously recorded summer stage, in a period of sixteen summers.

On June 9 and at intervals until the crest reached Sioux City warnings and information of the progress of the flood were sent to interests on the lowlands from Running Water to Meckling, S. Dak. Between Running Water and Springfield, S. Dak., and on the bottoms southwest of Tabor, S. Dak., there pasture large numbers of live stock which, with moderately high water, may find refuge on slightly elevated areas, but with higher stages would be lost. These lands begin to overflow when a stage of 13.5 feet is reached at Running Water. The highest reached at Running Water was 15.9 feet on the 22d, a stage that had been accurately forecast on the 19th. The Chicago, Milwaukee, and St. Paul Railway track was under water and washt out in places between Running Water and Springfield, and train service was not resumed for ten days from June 11. Aside from the loss to the railroad, amounting to about $1,000, no damage is known to have occurred. The deposit of silt on the bottom lands in that section was considered rather more beneficial than otherwise, as the pastures began growth with renewed vigor as soon as the water subsided.

In spite of the fact that the river at Bismarck was higher by 2.5 feet than it had been during the past three years, the highest stage reached at Sioux City was the same as it had been for the two previous years, 15.2 feet, on June 23.

In the Omaha river district the Missouri River was about 1 foot above the flood stage, but no material damage was done.

The same general conditions that caused the floods in the upper Missouri watershed extended southeastward thru the Plains States, and below the mouth of the Platte River conditions were much more serious, especially in Kansas and northwestern Missouri, where the flood was the third in magnitude in their history, taking rank immediately after those of 1844 and 1903. In point of duration it stands alone. The daily press published the fullest account of these floods, and the following reports are designed to cover only such details as are necessary to preserve a permanent record.

MISSOURI RIVER BELOW PLATTSMOUTH, NEBR., KANSAS RIVER AND TRIBUTARIES.

By P. CONNOR, Official in charge, Local office of the Weather Bureau, Kansas City, Mo.

As a rule, when there is a flood in the lower Missouri there is also one in the Kansas River, as both result from heavy rains in adjacent States. This year was no exception.

At the beginning of June all rivers in this district were at ordinary stages. Excessive rains in southern Nebraska on the 2d started a rapid rise in the Big Blue River. The flood stage

of 14 feet was reached at Blue Rapids, Kans., on the evening of that date, and the crest of 23 feet at 5 p. m. of the 4th. A recurrence of heavy rains in the same territory on June 5 again sent the falling stream upward to a crest height, on the morning of the 6th, of 34.2 feet, which was within 0.3 foot of the highest record, that of 1903. This was foreshadowed in a telegram sent the observer at Blue Rapids at 10:55 a. m., June 5, which read:

Very heavy rains in southeast Nebraska last night; four inches Fairbury indicate dangerous outlook for Blue Rapids and Blue Valley generally.

These rains also started a moderate flood in the Republican River, coincident with that in the Blue, reaching a crest of 21.6 feet in early morning of June 6 at Clay Center, Kans., 3.6 feet above flood stage.

Anticipating a flood in the Kansas River from the waters of those tributaries and the rains in prospect, a telegram was sent the river observer at Manhattan, Kans. (at the junction of the Blue and Kansas rivers), on the forenoon of June 4, advising that flood stage would be reached at that place on the 5th, the stage then being 14.7 feet and the flood stage 18 feet. On June 6, at 8 a. m., the stage was 18.6 feet, and warnings were sent to all post-offices between Manhattan and Kansas City and between Kansas City and Boonville, Mo. Warnings were repeated daily from the 7th to the 11th, inclusive, and on the latter date the following was published:

The Kaw shows a slight fall at Kansas City and decided fall at points west. There will not be much change in the flood level at Kansas City during the next twenty-four hours. The tendency of the Kaw will be downward, serving to check a rising tendency in the Missouri.

The latter river had risen steadily at St. Joseph from June 6, averaging 0.9 foot per day, and reached 14.4 feet at 7 a. m. on the 11th, which was very much higher than was indicated by the changes and stages above it. The volume of water coming down more than counterbalanced the diminishing Kaw, causing a slight rise in the flood level at Kansas City until 4 p. m., when the gage showed 28.6 feet. The river began to fall during the night of the 11th, and by 6 p. m. of the 12th the flood level had been lowered 0.6 foot. But this fall was not to go on uninterruptedly.

Heavy rains in the Kaw Valley on the night of the 11th started another wave in that stream, so that on the morning of the 12th warnings had to be repeated to Kaw River points. The following message was sent to Topeka:

Weather very unsettled. Outlook justifies assumption that flood stage will again be reached at Topeka Sunday (14th). People should be cautious.

Manhattan was also notified that flood was again indicated for that place. The local information given out for Kansas City read:

The Missouri River at Kansas City has fallen 0.3 foot below the maximum at 6 p. m. last evening. A decided fall is shown in the Kaw, but in view of the heavy rains last night and the liability of more, people should look upon the river situation with extreme caution and be slow to resume operations where the water has receded. There will not be much change in the flood level in the next twenty-four hours.

On Saturday morning, June 13, the following was published:

The heavy rains of last night will probably raise the flood level at Kansas City to about 30 feet by Sunday afternoon. The Kaw will respond to the rains, and the discharge will be retarded by the high stage of the Missouri.

The rivers in the vicinity of Kansas City continued rising during Sunday the 14th, reaching a crest height of 30.3 feet on the Missouri gage and 29.6 feet on the Stockyards gage Monday morning, June 15. After that the tendency was downward with a few slight fluctuations.

It will be seen from the foregoing that the flood was made up of two distinct waves. It not only attained a remarkably high stage, but it was a most remarkable flood, so far as the Missouri is concerned. The Kansas was out of its banks at Topeka and Lawrence from June 7 to 15; the Missouri was out of its banks at St. Joseph from June 4 to July 10, and at Kansas City from the night of June 7 to July 5, and on the 9th, 10th, and 11th. The rains were so timed that the river at St. Joseph did not vary one foot in height from June 11 to July 1.

The crest of the Kaw flood reached Manhattan at 4 p. m. June 7, 24.8 feet; Topeka at 3 a.m. June 9, 28.0 feet; Lawrence at 4 p. m. June 9, and in the vicinity of Kansas City about 9 p. m. June 10. The rate of crest movement from Manhattan to Topeka was 2.1 miles an hour; from Topeka to Lawrence 2.8 miles an hour, and from Lawrence to the vicinity of Kansas City 1.7 miles an hour, an average of 2.2 miles an hour. It is believed, however, that the crest movement in the latter section was retarded by the influence of the Wakarusa River which empties into the Kaw about six miles east of Lawrence. The crest of the 1903 flood moved at the rate of 2.6 miles an hour.

Rains started the Blue River on another rise on the 17th, and a stage of 25.7 feet was reached on the morning of the 20th. This was anticipated by a warning on the 18th. Altho the river was nearly 12 feet above flood stage at Blue Rapids, it only augmented the Blue and Kaw at Manhattan to one foot above flood stage.

Heavy rains in northwestern Kansas on the 15th, 16th, and 17th caused the greatest flood at Beloit, Kans., of which there is record, the water reaching a stage of 33.25 feet at noon on the 20th, 2 feet higher than the flood of 1903. The river was out of its banks on the 15th and 16th, but fell to an 8-foot stage on the 17th; it began rising rapidly on the 18th, going out of its banks again on the morning of the 19th. It fell below flood stage on the 22d.

The volume of rain that fell in the Kansas and Nebraska portion of the Kaw Basin during June was 11 per cent less than fell in May, 1903.

The Blue River cut a new channel about one-half mile above Manhattan, and water past thru it at a stage of about 13.5 feet. At the higher stages more water past thru the new channel than the old one, the former being very much the wider.

The Missouri River did considerable cutting in places, notably at Atherton and Sibley, Mo., below Kansas City. Some correspondents write that the land has been damaged by erosion or deposit, while others state that the benefits offset the damage. It appears to be a fact that the flood was a positive benefit of a permanent nature in many localities along the Missouri. Its long duration with only slight changes in its level from day to day, left the bottoms overflowed with very muddy and sluggish water so that sedimentation was very great. It has been found that local depressions have been raised as much as 3½ feet, while the common level of bottom land for long stretches has been raised a foot or more.

The situation at Kansas City was met very successfully. As soon as the first warning was issued, which was on Saturday, June 6, the community took the matter seriously and went to work vigorously. As a result all goods and household effects in the bottoms were transferred to higher floors or other places of safety, and the railroads took precautions that nothing susceptible of damage by water would be caught by the flood this year. Any damage that resulted from the flood was absolutely unavoidable. It was not a very destructive flood. It did not come with a mad rush as did the flood of 1903, when the river rose 7.5 feet in twenty-four hours, with the water previously all over the bottoms.

Armourdale, a portion of Argentine, and Harlem were depopulated, and the bottoms were entirely submerged. The water partially surrounded the Union Depot, but it did not go over the floor of the waiting room and ticket office, in contrast with the condition in 1903 when the water was 7 feet high in the ticket office, altho only 4.7 feet higher than in the present

year. This was due to the fact that the volume of water was less in the Kaw this year.

Much of the East Bottoms, especially that portion in which is located the larger interests, was protected from complete inundation by strenuous efforts on the part of the Kansas City Southern Railroad, ably assisted by the Missouri Pacific. The roadbed of the Kansas City Southern passes between the more densely populated portion of those bottoms and the Missouri River, the tracks being several feet higher than the general level of the bottoms. Hundreds of men were kept at work day and night with a construction train, placing bags of sand along the roadbed. These tracks and those of the Chicago, Milwaukee and St. Paul Railway afforded the only eastern outlet during the high water.

Floods appear to be on the increase in this section, and it may be difficult to find a satisfactory reason for it. Had this been a great timber region its clearing and development might in a large measure account for their recurrence, but it is part of the Great Plains whose aspect has been changed only by the cultivation of the soil. From 1844 to 1881 is a long stretch of years, yet no flood of any consequence occurred in that epoch. In the latter year a flood occurred which furnished the standard high-water reference for the community for the next two decades, yet the stage was only 26.3 feet. It proved to be, however, the greatest flood in fifty-eight years. Then followed the great flood of 1903 with its 35-foot stage, 14 feet above flood stage. In 1904 the river reached 25.2 feet, and in the present year 30.3 feet. Thus within five years occurred three most important floods, two of them being greater than any in the history of Kansas City, excepting that of 1844.

Man's desire to possess the earth has often led him to make a mistake when dealing with the forces of nature, and perhaps it is so in these flood matters. It must be admitted that heavy rains occurred in times past as well as in more recent years, and during those times flood waters were taken care of by channels shaped and dimensioned by the compelling forces of erosion where nature held sway. Now conditions have changed. The natural water courses have been encroached upon by obstructions, damming, and reclamation processes until, in many instances, they are barely more than half the original dimensions. A board of Government engineers, in a report dated January 23, 1904, made the following statement of the conditions at the mouth of the Kaw, or Kansas, River: "The channel has been encroached upon by riparian owners until its normal average width of about 850 feet (minimum 540) as shown by meander lines of 1856, is reduced to an average of about 590 feet, with a minimum in one place of 420 feet." The width of the Missouri at Kansas City, while it may conform to established harbor lines, has been narrowed from a 2000-foot channel to less than 1000 feet. At other river towns and cities the same spirit has been at work, and in these so-called improvements is to be found one of the real causes of recurring and destructive floods.

The following is a recapitulation of damage along the various streams and the value of warnings:

Blue Valley.—Damage to property other than crops, perhaps $200,000; value of crops destroyed, etc., $400,000; damage to farm land by erosion or deposit, $100,000.

Republican Valley.—Damage to property other than crops, very light; value of crops destroyed, etc., $300,000; damage to farm land by erosion or deposit, not much.

Solomon Valley.—Damage to property other than crops, not great; value of crops destroyed, etc., $300,000; damage to farm land by erosion or deposit, considerable in the upper portion, not much in the lower portion; loss by enforced suspension of business, not much.

Smoky Hill.—Eastern portion, value of crops destroyed or damaged, $100,000.

Kaw Valley.—Damage to property other than crops, about $55,000; value of crops destroyed or damaged, $1,500,000; loss thru suspension of business, not including the vicinity of Kansas City and Topeka, about $30,000.

Missouri Valley.—Plattsmouth, Nebr., to Boonville, Mo., damage to property other than crops, about $75,000; damage to crops of all kinds, $4,120,000; damage to farm land by erosion or deposit, $300,000; loss thru enforced suspension of business, not including Kansas City, $90,000. This loss pertains chiefly to business, as employees were engaged protecting against the flood and lost no time.

The total losses, excluding Kansas City, were as follows:

Property (exclusive of crops)	$300,000
Crops	7,320,000
Soils	500,000
Business suspension	200,000
Total	8,320,000

The long duration of the flood in the Missouri Valley has made it especially severe. It not only injured what was in the ground, but prevented replanting with anything.

The damage at Kansas City was very small compared with that caused by the flood of 1903, in fact the damage to property was very light considering the size of the flood. Twenty-three business institutions in the bottoms (some in Kansas City, Mo. and some in Kansas City, Kans.) reported a total damage to property of only $91,500. The same number report total loss by enforced suspension of business of $168,000, and value of property saved by the flood warnings of the Weather Bureau $1,324,000. The railroad losses were only about $350,000.

Next to Kansas City and vicinity, the city of Topeka, Kans., was the greatest sufferer. The total losses amounted to about $700,000, and it is estimated that property to the amount of $1,000,000 was saved thru the Weather Bureau warnings. The greatest damage probably lies in the depreciation of real estate values in the flooded districts, partly on account of actual damage to buildings, and partly on account of the feeling generally exprest that other floods will occur in coming years. On this account the county commissioners, after the waters had subsided, reduced the assessed value of real estate in North Topeka from $1,968,515 to $1,484,135.

The following editorial published in the Lawrence, Kans., Gazette of June 12, 1908, testifies to the general excellence of the work performed by the Weather Bureau during the flood:

> The Weather Bureau at Topeka did most excellent service during the flood and before it. The information the Gazette gave out came from there, and it was never wrong. Mr. Jennings gave out information that saved hundreds of thousands of dollars to the people along the Kaw Valley, and he and his department deserve the thanks of those in the track of the flood. From the very beginning he told hours, and once or twice days ahead just what was going to happen. And not only that, he also told just when it would happen at a given point. Time after time wild rumors would fly over the country, and every time the Gazette got track of one, it had it run down and stopped by news direct from Jennings. Sunday evening he told the Gazette just how much higher the river would go, and it went just that high and stopped. He also said that it would reach its highest point here not earlier than noon of Tuesday, and at noon Tuesday it had reached its highest point, and at 3 o'clock it was falling. The Gazette gave the warning sent it by Mr. Jennings to every farm house in the valley near Lawrence that could be reached by telephone, and everyone obeyed the message, and got out of the way of harm. The Weather Bureau saved more money during this one flood than it will cost to run it for years.

From Boonville eastward to the mouth of the Missouri River experiences were similar to those farther westward. Flood warnings were first issued on June 7 and crest stages as follows, were recorded: Glasgow, Mo., 27.2 feet on June 18, flood stage, 18 feet; Boonville, Mo., 28.2 feet on June 18, flood stage, 20 feet; and Hermann, Mo., 25 feet on June 20, flood stage, 24 feet.

The floods in the Mississippi watershed above Cairo, Ill., excluding the Missouri, were not general. There was a disastrous flood in the Minnesota River, and a moderate one in the Mississippi above the mouth of the Minnesota, but from Lake Pepin to the mouth of the Des Moines River there was no high water. Below the mouth of the Des Moines flood conditions were general during June, and much damage of the usual character was done, much of it being due to the prolonged duration of the flood. The following account of the floods in the Minneapolis, Minn., district, including the Minnesota River, was prepared by Mr. U. G. Purssell, Official in charge of the Local office of the Weather Bureau at Minneapolis, Minn.:

FLOODS IN THE MINNESOTA RIVER.

By U. G. PURSSELL, Official in charge, Local office of the Weather Bureau, Minneapolis, Minn.

Beginning with May 11, 1908, and continuing to the end of the month, frequent heavy rains occurred over the Minnesota section, producing the heaviest average monthly rainfall on record for the section. The precipitation was particularly heavy in the central Minnesota River watershed. At Winnebago and New Ulm the rainfall during May was over 11 inches, and at Mankato and St. Peter over 9 inches. During June the downpours were even heavier than in May, but they were of less frequent occurrence. The monthly rainfall was again especially heavy in the central Minnesota River watershed, in the upper Minnesota watershed and thence northeastward over a number of counties of the Mississippi watershed. At St. Peter the monthly rainfall was over 12 inches, at Mankato, Lake Crystal, New Richland, and Morris about 11 inches, and at Little Falls nearly 10 inches. These unusually heavy downpours caused the Mississippi River to rise above the flood stage at Fort Ripley on June 10, and to continue in flood at that point until the 15th, with a maximum stage of 11.0 feet on June 11. At St. Paul the river was above the flood stage from June 2 to 17, inclusive, with a maximum stage of 15.0 feet on the 14th. It again went above the flood stage on June 27, and continued in flood until July 5, with a maximum stage of 16.8 feet on June 29. This latter flood came from the Minnesota River.

The Minnesota River at Mankato, rose steadily from the middle of May, and rapidly during the last four days of that month, to 17.5 feet, 0.5 foot below the flood stage, on May 31. It then fell steadily to 10.1 feet on the 18th of June. It rose 2 feet from the 18th to the 22d, and then 4 feet in twenty-four hours, from the 22d to the 23d, as a result of a tremendous downpour of more than 5 inches in twenty-four hours, which occurred in Waseca County on the 20th. Excessive rains in a number of counties on the central Minnesota River watershed from the 20th to the 23d, caused the stage to increase rapidly to 21.2 feet on the 26th, and it then decreased slowly to 17.8 feet, or 0.2 foot below the flood stage, on the morning of the 30th. The water receded at the rate of 0.5 to 0.9 foot per day from June 30 to July 5. The rise of the water in the first flood in the Mississippi River was so gradual that no serious damage was done. Until June 12 the regular daily bulletins kept all interests fully informed. On that date a special warning was issued, forecasting a stage of 15 feet at St. Paul within forty-eight hours. This stage was reached at that place on the morning of the 14th. The dwellers on the river flats in St. Paul were much inconvenienced by being driven from their homes, and considerable damage was caused to lands and crops by overflow on the river bottoms.

The flood in the Minnesota River which caused the second and greater flood in the Mississippi River at St. Paul was very destructive in the Minnesota Valley. Timely and frequent warnings were issued until the crest of the flood past the various cities in the lower valley from Mankato to St. Paul, and all movable property was saved, but all crops in that portion of the valley were destroyed. The loss of bridges and fences and the damage to highways were enormous. At Mankato and at other points the railroads suffered heavily from washouts and interruption to train service. On the Mississippi the loss was confined principally to suspension of business in the sawmills from Minneapolis to St. Paul and at Little Falls, and to dwellers on the low levels, who were driven from their homes and compelled to live in tents and box cars for several days.

The money value of property destroyed or amount of damage, exclusive of crops and including railroads, is estimated at over $750,000. The money value of crops destroyed or damaged is estimated to be at least $300,000. Damage to farm lands by erosion or deposit, $50,000. The damage from deposit is thought to be temporary, as the silt was mainly washt from fertile soil and there was very little gravel deposited.

The money value of losses occasioned thru enforced suspension of business, including wages of employees, is estimated at $200,000.

The money value of property saved by the flood warnings of the Weather Bureau is estimated to be at least $400,000. No lives were lost as a direct result of the flood, and 90 to 100 lives were saved as a direct result of the Weather Bureau warnings. The city of Mankato suffered severely from an epidemic of fever immediately after the flood, which was thought to have been caused by contamination of the city water supply by flood water.

In the Hannibal, Mo., district the losses of about $100,000 were principally to crops, and were due to the fact that the extreme duration of the flood prevented any replanting, the high water persisting from May 28 until July 12.

The first warnings for the Mississippi River from below Hannibal to St. Louis were issued on the 7th, and they were repeated daily until after the decline was well marked. The forecasts made from June 16 to 18, inclusive, predicted a crest stage of between 34.5 and 35 feet at St. Louis within a few days, and a maximum stage of 34.9 feet occurred on the 20th and 21st. The river was above the flood stage of 30 feet from June 9 until July 8, inclusive. The following statement relative to the extent of the overflow and the losses resulting therefrom was prepared by Mr. O. C. Burrows, of the Local office of the Weather Bureau at St. Louis. The figures given include that portion of the Missouri Valley east of Kansas City not previously mentioned.

FLOODS BETWEEN HANNIBAL, MO., AND ST. LOUIS, MO.

By O. C. BURROWS, Assistant, Local office, Weather Bureau, St. Louis, Mo.

The levees along this portion of the Mississippi, while inadequate, afford greater protection from overflow than do those along the Missouri, and have been raised and strengthened since the flood of 1903. As a result much valuable farm land, that would otherwise have been inundated, was protected. The American Bottom, a tract 95 miles in length, extends from below Alton, Ill., to the vicinity of Chester, Ill., on the Illinois side of the river, with few levees of importance, and it was in this district that the greatest damage from the flood occurred. The greater portion of the tract was under from one to ten feet of water which in places extended back eight or ten miles to the bluffs. The area submerged between Hannibal and Chester was about 300,000 acres, at least half of which was under cultivation. The total area overflowed, between Boonville, Mo., and the mouth of the Missouri River and between Hannibal and Chester on the Mississippi River, was about 600,000 acres, nearly 50 per cent of which was under a high state of cultivation. In addition to the farm land which was inundated, there were a number of towns and cities wholly or partly flooded. On the Missouri River, Cedar City, Craig, Corning, Woolridge, and Overton were flooded, and on the Mississippi portions of Alton, Venice, Madison, National City, Granite City, East St. Louis, Ill., and St. Louis

were submerged. The inundated district in St. Louis was confined to Front street and to railroad tracks on low ground in the northern portion of the city. A few railroad embankments gave way in East St. Louis, and small areas were flooded. The loss in the two cities was, therefore, nominal, and resulted mostly from the suspension of business in the overflowed districts. The loss of, and damage to, property for the entire district was about $500,000, and the value of the crops destroyed was about $4,000,000. Damage to farm lands by erosion and deposit amounted to about $100,000. The loss sustained thru the suspension of business amounted to about $200,000. Timely warnings, issued in advance of this flood, gave ample opportunity for the removal of all portable property and live stock from the threatened districts to places of safety, and it is estimated that property to the value of $750,000 was saved by heeding them. There was no loss of life due directly to the flood, so far as press reports show. Between Louisiana, Mo., and the mouth of the Missouri River the stages were not alarming.

More moderate floods occurred in the Mississippi River from Chester to Cairo, Ill., for which warnings were issued as occasion required. While these warnings were frequent and accurate, much damage of an unavoidable character was done. The season was so late that the floods were much more destructive than usual, except in the vicinity of Chester, Ill., where the damage was small. Below Chester the losses and damage amounted to about $850,000, principally to growing crops. There were also local floods in small streams in various portions of the country during the month of July, due to heavy rainfall. Considerable damage was done in interior New York, northern and western Maryland, southern Virginia, southeastern Nebraska, Colorado, and southwestern Idaho.

The highest and lowest water, mean stage, and monthly range at 207 river stations are given in Table IV. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

SPECIAL ARTICLES, NOTES, AND EXTRACTS.

RAIN-MAKING IN NEW ZEALAND.

An article on experiments in rain-making in the New Zealand Times of Wellington, October 23, 1907, lately came to the attention of the Editor as another illustration of the waste of public money consequent upon popular ignorance and superstition. Of course it is not to be expected that every one should appreciate the positive knowledge that constitutes meteorology, but it is to be hoped that every illustration of this kind may contribute something to the education of the public.

We understand that both climatology and meteorology are combined in the Meteorological Office of New Zealand, but that of course the former branch of the science is likely to receive the greater amount of attention. It would seem that the people and the Government initiated the rain-making business at Oamaru in the North Otago district which had been suffering from a drought for several months; and it was only left for the Meteorological Office to send the Rev. D. C. Bates, F. R. M. S. and Government Meteorologist, to watch the experiments and report on the results. Of course he knew that the production of rain by cannonading is hopeless, and it would have been proper to regard the experiment as a stupendous farce. But it had a tragic aspect, since on the one hand he, on arriving at Oamaru, seems to have been hailed as a plenipotentiary armed with dynamite, guncotton, gunpowder, special railway trains, motors, and a posse of troops to do his bidding, in the presence of thousands of strangers. On the other hand, the local rain-making committee had caused the churches to offer up prayers for rain and for the success of the experiments, and now stood ready to denounce both religion and science if rain did not follow the cannonading. It seemed like a contest between paganism and intelligence in which forbearance, silence, and patience are the better weapons.

The official report by Mr. Bates has been published almost entire in the local papers of New Zealand and we reprint it as a most instructive scientific and educational document. The result should go far to prevent other communities from making such foolish experiments and should draw the attention of every one to the need of saving the rainwater after it has fallen. It is a case where conservation is possible and production impossible.—*C. A.*

REPORT UPON THE DRY PERIOD AND RAIN-MAKING EXPERIMENTS AT OAMARU, NEW ZEALAND.

By D. C. BATES, Government Meteorologist. Dated Wellington, N. Z., September, 1907.

The district of North Otago, often called after its chief town, the Oamaru district, is sheltered on the west, north, and south by mountainous ranges, which condense and precipitate on their windward slopes much of the moisture borne by the winds from these directions, and it must therefore depend chiefly on easterly weather [winds] for its rains. The northeasterly and southeasterly winds which accompany cyclonic disturbances and are usually laden with water-vapor, sweep up the Kakanui and Waitaki valleys, causing the most abundant rains to fall over the district. In some seasons, however, these atmospheric movements do not extend their influences so far south, and then, while the North Island gets more than the usual amount of rain, those parts of the South Island depending upon them are liable to experience droughts. A prolonged dry period of an unusually severe character for any part of New Zealand, extended over the Oamaru district during the years 1889, 1890, and 1891. The years 1897 and 1898 were also very dry, and the last period of deficient rainfall from January, 1906, to August, 1907, was 45.7 per cent below the sum of the average monthly rainfalls for the eighteen months included.

Rainfall observations for the Meteorological Office have been kept at Windsor Park, Oamaru, since 1892 by Messrs. E. and W. Menlove; also at Kauroo Hill, near Maheno, by Messrs. R. A. Chaffey, C. de V. Teschemaker, and A. French from January 1, 1890. While in Oamaru I learned that much older records, extending from 1866 to 1893, had been kept by the late T. W. Parker, esq., Resident Magistrate, and these were presented to the Meteorological Office by Mr. H. Edwards, who had continued Mr. Parker's work for a few years. Another valuable record, from 1888 to the present, with many interesting details of the effects of the weather upon pastoral and agricultural affairs, was also loaned us by Mr. Jas. Macpherson of Totara Station.

The annual rainfalls for Oamaru are as follows:

TABLE 1.—*Annual rainfall at Oamaru, New Zealand, 1867 to 1906.*

Year.	Inches.	Year.	Inches.	Year.	Inches.	Year.	Inches.
1867	23.58	1877	26.75	1887	26.28	1897	14.12
1868	25.73	1878	20.26	1888	29.10	1898	15.96
1869	18.33	1879	25.26	1889	14.33	1899	27.41
1870	32.32	1880	20.37	1890	14.15	1900	20.36
1871	16.32	1881	13.47	1891	16.60	1901	18.79
1872	19.93	1882	25.67	1892	23.03	1902	29.56
1873	28.00	1883	28.23	1893	20.04	1903	18.37
1874	21.79	1884	26.82	1894	23.71	1904	19.62
1875	23.39	1885	16.81	1895	24.26	1905	23.26
1876	17.20	1886	26.36	1896	23.75	1906	14.81

The average rainfall for these forty years is 21.87 inches;

the maximum of 32.82 inches occurred in 1870, and the minimum, 13.47 inches, in 1881.

TABLE 2.—*Precipitation data for Oamaru (Windsor Park), New Zealand.*

Months.	Means, 1867 to 1906.		During the drought.			
	Rainfall.	Days with rain .01 or more.	Rainfall.		Days with rain.	
			1906.	1907.	1906.	1907.
	Inches.		*Inches.*	*Inches.*		
January	2.24	12	.....	0.43	.....	5
February	1.88	11.6	1.25	1.39	13	9
March	1.32	9.7	0.52	1.41	10	11
April	1.73	9	1.16	0.58	5	7
May	1.62	8	0.73	0.71	4	2
June	1.78	7.4	1.42	0.24	5	4
July	1.67	8	0.59	0.56	6	7
August	1.47	8	0.59	.....	4	.....
September	1.89	9	1.46	.....	8	.....
October	1.55	10	0.62	.....	7	.....
November	1.98	11	0.95	.....	5	.....
December	2.30	13	2.46	.....	10	.....
Year	21.43	116.7	.....	.....	.....	.....

These figures indicate that the expectancy of rain is greater in summer than in winter. Furthermore, at Windsor Park during 1906 and 1907 only one month (December, 1906) had a total rainfall above the average, and that by merely 0.16 inch.

As might be expected in that undulating country, the records from Kauroo Hill station differ from the above very considerably at times. The averages from the seventeen years' records at Kauroo Hill, and the quantities during the eighteen months' dry period, January, 1906, to July, 1907, are given in Table 3.

TABLE 3.—*Precipitation data for Kauroo Hill, New Zealand.*

Months.	Means, 1890 to 1906.		Rainfall during drought.	
	Rainfall.	Days with rain.*	1906.	1907.
	Inches.		*Inches.*	*Inches.*
January	2.61	9.8	.....	0.46
February	2.19	7.8	1.42	1.95
March	1.68	6.6	0.49	1.63
April	1.24	6.3	0.99	0.78
May	0.94	4.5	0.71	0.80
June	1.18	4.4	1.19	0.23
July	1.28	5.0	0.48	0.50
August	0.69	4.6	0.50	.....
September	1.97	8.2	2.29	.....
October	1.42	8.0	0.45	.....
November	2.08	9.4	0.98	.....
December	2.31	10.9	.....	.....
Year	19.59	85.5	.....	.....

* Number of days with .005 inch or over.

The total at Kauroo Hill for this period is thus found to be 39.1 per cent below the average.

The results of this small rainfall, though by no means comparable with the effects of droughts I have experienced in the heat of Australia, were more severe than I had imagined possible in this country. The fields were very bare, especially new pastures which had been sown with English grasses in the past few years. The fields which were being plowed showed a dry subsoil which had apparently not been moistened by a good rain for a long time. I drove over a great part of the district and saw only one small field of fair-sized turnips, while on an average between 50 and 60 truck loads of these roots were being brought from Southland every day for northern and central Otago. The stacks of straw which the farmers have at last learned to save at harvest time, were commanding high prices, and in addition quite 9,300 tons of fodder had to be imported by the settlers to keep their starving stock alive. This food was carried free for the purchasers from the south, who were thus relieved of a great stress and encouraged to save their stock. Much of the stock had to be removed elsewhere for pasture and sold off or killed, but nearly all left were in very poor condition, and I attribute the fact that very few dead are seen in the fields to the timely and generous assistance of the Government.

The acreage and yields for the Waitaki agricultural district for the past ten seasons, as published by the Agricultural Department, show a lower yield in wheat for 1906–7 than any year since 1897–98, while the yield per acre in oats was the lowest recorded.

TABLE 4.—*Acreages and yields in wheat and oats, Waitaki district.*

	Wheat.		Oats.	
	Acres.	Average yield per acre.	Acres.	Average yield per acre.
		Bushels.		*Bushels.*
1897–98	37,955	13.2	21,080	21.7
1898–99	44,423	36.6	19,268	43.3
1899–1900	29,936	36.4	21,216	48.2
1900–1901	22,347	31.4	24,696	48.6
1901–2	18,558	32	23,094	38
1902–3	21,594	39	27,075	55
1903–4	27,112	39	22,376	42
1904–5	28,808	40	18,567	47
1905–6	27,927	32	20,655	41
1906–7	24,925	20	19,688	20

To sum up this aspect of affairs I would like to quote a concise statement by the Oamaru correspondent of the Wellington Evening Post (August 12, 1907), who says that—

> The eighteen months' drought at Oamaru has cost the district not far short of a million sterling. On the last grain harvest, as compared with previous averages, there was a loss of £200,000, and loss on the decreased output of butter ran into nearly another £50,000. It has been computed that about 75 per cent of cattle and 50 per cent of sheep that were in the district twelve months ago have been potted or exported to more favored districts.

Under such trying circumstances it was tantalizing to the farmers to hear of good rains falling in other parts of the country, and to see the clouds at such times hang over the mountains or passing away, high up in the air, to the ocean. Such disappointment as they so frequently experienced led many inhabitants of the district to regard favorably the project of experimenting for the purpose of inducing the clouds, at some favorable opportunity, to yield their moisture. Several of the most progressive, enlightened, and experienced farmers and business people who have the best interests of the community at heart—men who support local affairs such as pastoral and agricultural shows, and who have introduced and experimented on new seeds and strains of stock in the district, promoted the experiments, arguing that it *might be possible*, for a small outlay, to secure results of infinite value. The promoters were men who commanded the respect and sympathy of the public, and a large sum of money was readily subscribed. This amount, thru the efforts of Mr. J. Macpherson, M. H. R., was also supplemented by the Government, and given its greatest power of purchase through the supply of explosives at cost price from the Defense Department of New Zealand. I was ordered to proceed to Oamaru simply to watch and report upon the proposed experiments.

On my arrival I was met by the members of the committee who had the matter in hand and, while disclaiming all responsibility for the experiments, I discussed the project freely with them, finding their idea was to seek favorable opportunities to cause the passing clouds to precipitate. They desired me especially to advise them as to these, and to indicate times when the air would be saturated with moisture, or (to adopt a phrase of the late meteorologist, Rev. Clement Ley) the existence of such a state of "unstable equilibrium" as might possibly be disturbed and the "water-dust" of the clouds be made to coalesce and precipitation ensue. They did not hold that they were able to produce rain at any time, but firmly believed that they could only operate successfully in a cloudy and saturated atmosphere.

Tho I could not share their very sanguine hopes for such results as they desired, yet I tried my best to meet their views, and to the utmost of my abilities cooperated heartily with the committee. I only wish that more of the committee could have witnessed the experiments and, with the press, also come to definite conclusions.

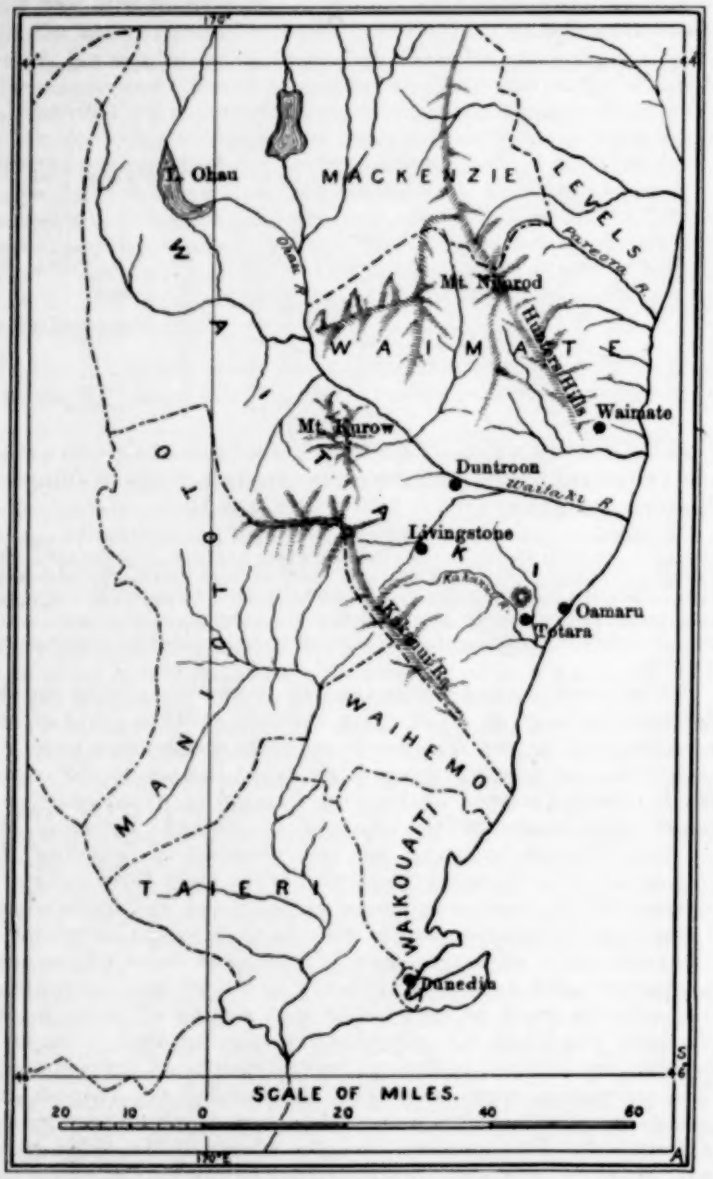

FIG. 1.—Sketch map of part of the North Otago district, South Island, New Zealand.

Rain was badly wanted, and at first the committee were too much in earnest, both in their faith and efforts, to regard the experiments in the light of purely scientific experiments. As is well known, rainfall is one of the most uncertain elements in meteorological prognostication for such a district, and the "probability of rain" with certain disturbances, rarely amounts to absolute certainty. But events were moving in such a manner that I could forecast periods of saturation in the near future [due to such meteorological causes as are ordinarily recognized on any weather map]. The times thought most favorable for rain, fortunately for the district, coincided very nearly with such widespread and abundant rainfalls as had not occurred for years, and on this account, my task of giving conclusive evidence as to cause and effect in the experiments was, unfortunately, rendered more difficult. While admitting this, I desire most clearly to maintain that in no case was I able to trace such effect or success in rain-making due to the explosions, as some local residents claimed with considerable assurance at the time. I have, moreover, read the records of similar experiments made on November 27, 1901, on Raki's Table which were referred to with even greater confidence. Rain did fall at that time, but I find from our records that the fall was heavy and general between Cape Campbell and Dunedin. The reports of the effects of the explosions on the clouds, barometer and hygrometer, are interesting but by no means of a convincing character. For example, one report states that "before the experiment the barometer stood at 28.95 inches, and five minutes after the explosion it fell to 28.92 inches, ten minutes afterward to 27.75 inches, and was apparently continuing downward when we left the Table." Now a fall of the barometer, in the open air, of at least one and one-fourth inches, would probably show a world's record for all time,[1] and one need hardly discuss the possible effects of such a drop. We might almost speak of it as a vacuum in the atmosphere. The chief claim for other experiments was based on this reported change. In every case where the committee and myself watched reliable barometers near the explosions, only a slight quiver was noticed at the moment of detonation, while the instruments went on steadily rising or falling as at other neighboring places.

The sites chosen for the experiments were lonely hills which commanded views of the whole district, and on that account had all been used as trigonometrical stations for the survey of the district. (See the map, fig. 1.) The chief site is Raki's Table, a flat-topped hill 1,059 feet above sea level and 14 miles inland as the crow flies, north-northwest from Oamaru. Round Hill, on the Totara Estate, is a remarkable cone with an elevation of 501 feet above mean sea level and about six miles southwest from Oamaru. Dalgety's Hill, near Duntroon, is in the Waitaki watershed, about 811 feet above mean sea level and 15 miles northwest from Oamaru. The positions had been carefully chosen by the committee, and both the situations and elevations were admirable for the purpose. The aim was to work with the wind rather than against it, and it was hoped that we should be able to trace the effects of the explosions on the clouds over the area affected.

THE FIRST SERIES OF EXPERIMENTS.

On the afternoon of August 16 the skies were dull; stratocumulus clouds hung round the hills and were scattered overhead. It appeared even to be raining at a distance away to the south, but the weather was quite fine for us on our way to Arnmore station, near Raki's Table. I arrived at Mr. P. I. Shand's residence about sunset, and although heavy, misty clouds were falling on the Table and residents thought rain imminent, there did not seem to be sufficient density about the clouds. The air showed a relative humidity of 92 per cent, and only needed a fall of 2.4° in the thermometer to reach the dew-point. The cool of evening was approaching and the wind, tho light, was in the rainy quarter, the southeast. On the whole, the conditions were regarded as fairly favorable. It was regarded chiefly as a trial of the bombs and for working the men together under Corporal Meikle prior to using the other stations.

The explosives used on this occasion were:

(1) 5:15 p. m... 17½ lbs. dynamite, 12½ lbs. powder, in keg.
(2) 5:30 p. m... 17½ lbs. dynamite, 12½ lbs. powder, in keg.
(3) 5:45 p. m... 40 lbs. dynamite, 25 lbs. powder, in case.

These behaved differently. The first shot gave off a good report, and the smoke rose and drifted gently away to the northwest. The second did not explode well, for the powder seemed to burn in the air without detonation. The third shot, which had a weight of 65 pounds, gave a great concussion to the air, and vibrations were felt over a wide area.

[1] It is a physical impossibility.—*C. A.*

As far as I could see, however, there were no other than natural changes going on in the atmosphere. With the committee I left for Oamura at 10 p. m., and the evening was quite fine. In the Oamura Mail, however, next day, the following paragraph appeared:

As showing that the explosions which took place last evening, altho modest compared with what are to follow, were not altogether unaccompanied by that practical result which farmers look for as the outcome of the experiments, it may be mentioned that Mr. George White and several other farmers were conversing on the probability of rain descending from a certain cloud which appeared to be hanging on Tokaraki, if unsettled by concussion, at the time the bombs were, altho unknown to Mr. White and his friends, being tested on Raki's Table; and as they conversed they were surprised to hear the boom of the explosions, and immediately afterward a shower of rain, lasting for half an hour, fell in the vicinity of Hilderthorpe. This may have been a coincidence, but as a coincidence it is remarkable.

As a result of this trial it was decided that the explosions should be given more resistance, fired off rocks, and at the next opportunity detonated almost simultaneously from the other stations. A small cannon with a few pounds of common powder would, in my opinion, have given greater vibrations of sound and a shorter and sharper shock in place of the dull and heavy report of these powerful explosions. I believe that the cannons used in Europe for this purpose are of the blunderbuss type, but I would not advocate their purchase; for tho numbers of these have been employed together, and some sending "vortex rings" up to great heights have had great claims made for them by their vendors, yet they are by no means recommended by those meteorological experts who have investigated their claims. They have been used mostly for the prevention of hail, to drive it away or to cause the cloud to precipitate as rain before the formation of hail. Theoretically one would imagine the heat caused by these explosions would tend to dissipate the clouds, the friction of the vortex rings especially would be able to create but slight disturbances in the air, which would not induce precipitation, but naturally rather the reverse.

THE SECOND SERIES OF EXPERIMENTS.

On Sunday, August 18, the coming of what appeared to be merely a westerly area of low pressure developed into a cyclone, which promised greater rain and sooner than it would have come from the ordinary type which would have culminated between the 19th and 20th. There was a drizzle falling on Sunday morning at Oamaru at 4 a. m., and at 9 a. m. 0.04 inch was recorded. The day was dull and threatening and rain set in again at night; 0.40 inch was recorded in the morning. At Totara Station in the Kakanui Basin, Mr. Macpherson recorded 0.73 inch. The rain was mostly confined to the seacoast while the barometer was falling. It was 29.99 inches on Saturday, and 29.47 inches on Monday at 9 a. m. I expected much more rain would come with the rise of the barometer and the shift of the wind to the south, but as yet hardly any rain had fallen inland. The rain held off, but the skies continued cloudy. The committee decided to experiment at Raki's Table when they heard no rain had fallen there. We left Oamaru at 12:30 p. m. on the 19th, and as we got out into the country found the roads dry, but "bad" weather was evidently working inland and there was a very slight drizzle falling as we arrived at Armore about 1:45 p. m. Corporal Meikle was then making an explosion which apparently had no effect, tho the hygrometer showed that the air was saturated with moisture. Earlier, at 12:30 p. m., another shot had been fired, and the artillerymen and others affirmed that it drew rain in fifteen minutes, and brought the clouds down on the Table so that the view of the surrounding country was obscured. We missed the artillerymen on the road but in company with Mr. Shand, I at once visited the top of the Table. We found the wind strong and gusty from the southeast. The sky was dark and lowering and two showers fell before the artillerists returned. Raki's Table was then enveloped in a thick Scotch mist, spitting with rain, but heavy showers soon set in and continued to fall at intervals. I regarded these as perfectly natural, and was confirmed in my opinion when I learned that the rain squalls had had the same intermittent character long before they reached us. It could hardly be maintained that the explosions would have so marked an effect as this on the rain 14 miles away, and against the sweep of a wind averaging, at the Table, about 25 miles an hour. While I saw no perceptible difference made in the showers sweeping down upon us and moving over the country, others were quite as decided in their opinions that the rain thickened heavily after each successive shot.

The barometer continued to rise, and those who watched the instrument agreed there was no fall after the several shots. The weather continued very raw and wet, but the hygrometer showed the same dew-point as before.

The explosions were as follows:

Time.	Guncotton.	Dynamite.	Gunpowder.	Weight of charge.	How made up.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	
(4) 12:30 p. m.		50		50	In 5-gallon oil drum.
(5) 1:45 p. m.			50	50	Do.
(6) 3:56 p. m.		50		50	Do.
(7) 4:05 p. m.		65		65	In case.
(8) 4:17 p. m.	50	60		110	Do.
(9) 4:30 p. m.	50	100		150	Do.
	100	325	50	475	

Rain fell on the 19th and 20th over a very wide area in the South Island, and the falls recorded at this time by the observers of the Meteorological Office are as follows:

	Windsor Park.	Otekaike.	Livingstone.	Armore.	Kurow.	Waimate.	Oamaru.	Totara.	Kauroo Hill.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
18th...	.16	.00	.00	.03	.00	.00	.40	.73	.00
19th...	.53	1.15	.70	.52	1.17	.03	.36	.40	.10
20th...	.00	.15	.53	.09	.12	.50	.00	.06	.70

The falls were very different at the various places, but such widespread and heavy rains could hardly be attributed to artificial means.

THE THIRD SERIES OF EXPERIMENTS.

On the 22d everything was ready for a trial upon a larger scale. There was a cloudy sky, a rapidly falling barometer, following a frosty night, and local indications fell in with the wider aspect of affairs, suggesting "rain before long."

The explosions on August 22, 1907, were as follows:

RAKI'S TABLE.

Time.	Guncotton.	Dynamite.	Gunpowder.	Weight of charge.	How made up.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	
(10) 3:30 p. m.		100		100	In 10-gallon oil drum.
(11) 3:40 p. m.		100		100	Do.
(12) 3:50 p. m.	50	150		200	Do.
(13) 6:00 p. m.		150	50	200	In case and keg.

DALGETY'S HILL, DUNTROON.

(14) 3:30 p. m.	33	67		100	In 10-gallon oil drum.
(15) 3:39 p. m.	33	67		100	Do.
(16) 3:49 p. m.	33	67		100	Do.

ROUND HILL, TOTARA.

(17) 3:30 p. m.	25	25		50	In guncotton case.
(18) 3:40 p. m.	25	25		50	Do.
(19) 3:50 p. m.	25	25		50	Do.
(20) 3:55 p. m.	25	25		50	Do.

The charges were primed with dry guncotton and fired by dynamite detonator attached to a slow-burning fuse. In nearly all cases complete detonation took place, but it would have been much more satisfactory had each case of explosives been

connected and the explosions made by electric current. In one instance it was noticed that three cases of dynamite exploded, one upward and two others sideways, and not quite simultaneously, so that it appeared as if a single cap was not sufficient for complete detonation. However, we thus had both effects—explosions ballistic in character and detonations shattering.

From Raki's Table I watched the experiments at Dalgety's Hill, 5¼ miles to the northeast, and those at Round Hill, 9½ miles to the southeast. The skies were again very heavy—stratus clouds,were between 800 or 1,000 feet above the Table most of the time, and hung low, but well defined underneath all round, excepting in one bright patch away to the southwest, where there was an arch over a mountain range. The wind at first was light northwest, and later shifted to the southwest without much change in the clouds, except perhaps they lowered as the evening advanced. This time, so far as I could see in any direction, there was no apparent change made by the explosions. The smoke drifted upward and then gently away on the breeze. The barometer fell slowly all the time and the high relative humidity approached saturation at sundown; but though the mist looked heavy all about, the rain was not quite ready and explosions did not seem to expedite matters. Up to that time the experiments certainly were ineffective in the precipitation of rain. It did, however, come some hours afterward, and some people in the locality might possibly attribute this result to the experiments, but those who were actual eye-witnesses on those lonely heights could, I imagine, hardly entertain such ideas. These efforts were puny in comparison with the mighty forces which were at that moment developing independently over thousands of square miles in a cyclone similar to, but more intense than, the one which had brought rain only a few days before. It did seem indeed to be following in its tracks.

Rain commenced at Oamaru about midnight with a northeast wind, and was general thruout the district of North Otago. Tho Central Otago did not benefit as much as expected, yet so far as the Oamaru district was concerned, the dry period was at an end and there was great rejoicing everywhere.

The rainfalls of the locality are placed, as usual, to the credit of the day preceding the morning on which they are read, and are as follows:

Aug.	Windsor Park.	Otekaike.	Livingstone.	Arnmore.	Kurow.	Waimate.	Oamaru.	Totara.	Kauroo Hill.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
22d ...	.47	.19	.41	.35	.23	.43	.39	.30	.31
23d ...	1.44	.88	1.12	1.65	.44	2.10	2.02	2.24	1.88

GENERAL OBSERVATIONS.

Besides the valuable statistical information acquired by me in Oamaru, an increased interest in meteorology itself has, I trust, been a direct outcome of these experiments in the district. Tho science may not yet be able to forecast drought periods, yet they may be promptly recognized, and then with the aid of experience to be gained from other lands, they may be combatted on scientific lines, thus by turning adverse circumstances to good account, success may be wrested even from apparent failure. These costly efforts at rain-making are regarded at present, as misguided and vain by all scientific meteorologists, while to their chagrin really valuable work is often neglected for want of public interest. On this visit I have established four new third-class stations for the observation of rainfall in the Oamaru district, and I would earnestly recommend the establishment of one second-class station at Oamaru.

The whole matter in regard to rain-making experiments resolves itself into the question—Can man according to the dictates of his own needs, either directly or indirectly, produce rain upon the earth? Professional rain-makers in civilized countries have made repeated efforts by various methods to cause rain, but from America, Europe, India, and Australia come records of their failure, and only personal experience seems to satisfy each nation and each generation of their futility.

The chief arguments used in favor of the experiments, besides those alluded to before, were that rain generally followed great battles, explosions, and disturbances of the air as by reverberations of thunder—nay, even the passage of a railway train thru a moist-ladened atmosphere. I was informed that in parts of Wales, where slate quarrying is carried on, it usually rains every day while blasting is done, but that the Sundays will be fine because operations cease. Reviews of troops and sham fights have been followed by rain, and this has been attributed to the firing. The coincidence of rain with reviews has often been unduly imprest upon the minds of people by its effect on smart dresses and uniforms, for the display of which, and for convenience in marching, cumbersome overcoats have been discarded, and this fact discounts such evidence. Prof. T. Russell, in his "Meteorology," says:

> It has been supposed that concussion of artillery fire in battles produces rain, and that great battles are followed by heavy rain. There is no reason why this should be so. No physical relation has ever been traced between concussion of air and formation of water-drops. The belief is very ancient that battles are followed by rain. In Plutarch's Lives it is related that after the battle of Marsalia, in France, a great rainfall followed, and it is mentioned as being a well-known fact that all great battles are followed by rain. This was certainly a case when rain was not due to artillery fire.

Globules of water are formed around particles of dust and the vapor atoms of gases, or ions, but there is no reason to suppose that these droplets are hollow vesicles which could be burst by explosions. Condensation is induced in a supersaturated atmosphere by the presence of dust, the fumes of ammonia, phosphorus, sulfur, etc., since these particles form nuclei for the minute spherical drops of water. The passage of a train might bring such [dust] in smoke, but the results would only be insignificant. Fog from smoke may rest over London, but the rain is no greater than in the country. Again, thunder and lightning are effects of electrical disturbance, which latter is also a result of the usual cause of precipitation, viz, a cooling of a vapor-ladened atmosphere. A thunderstorm is caused by the meeting of winds from different sources, one warm and moist and the other dry and cold. These may meet laterally, or there may be an overturning of the atmosphere when they suddenly meet above. The latter idea is theoretically the nearest approach to what is sought by advocates of explosions as a means of causing rain to fall. The sudden conversion of a solid explosive substance into gases perhaps 1,500 times greater in volume, is accompanied by force and heat, and tremendous expansion. This drives the air about in every direction and, until diffusion of the gases took place, would create a state of atmospheric instability. Condensation first takes place aloft, then possibly drops fall, introducing a cooler current which might cause local showers, such as fall from the cumulus or anvil-shaped thunderstorm clouds caused by "unstable equilibrium." For such effects I watched most carefully, but the explosions had apparently no more effect in this direction on the vast expanse of the air than would the striking of a match in a room.

The natural forces arrayed against artificial changes in the atmosphere are tremendous—almost beyond conception. A unit of heat is the amount needed to raise the temperature of a pound of water 1° F., but nearly a thousand such units are needed to transform a pound of vapor. When vapor returns to water, latent heat is liberated in a corresponding amount. Now an inch of rain corresponds to 21,635 gallons, or 100 tons, 3 quarters, 26 pounds of water to the acre, or over 64,640 tons to the square mile. The heat developed or released by

the condensation from vapor to water for an inch of rain to the square mile is estimated as equivalent to the work done by 100,000,000 horse-power for half an hour. Consider then the sweep of a wind, five hundred miles wide and three miles high, blowing for an hour at the rate of twenty miles. The force of the mightiest explosion with all its gas put forth into the air is, in comparison, less than a drop in a bucket.

First and last, rainfall is always concerned with temperature in its relation to the aqueous vapor. Air at different temperatures will hold different quantities of water-vapor which is an invisible gas and lighter than the air itself. For example, at 80° F. two cubic feet of air will sustain 22 grains weight of vapor; at 60° F. the same measure would hold 11½, but at 32° only 4½ grains. Any additional moisture would be condensed at those temperatures, or a lowering of the temperature of the saturated air would have the same effect, namely, condensation. At ordinary temperatures the capacity of the air for vapor is doubled for every 18° F. Cooling the air by mixture of a cold upper current with a lower warm and vapor-ladened one, or the meeting of tropical and polar winds in circulating storms, or the impinging of a warm and moist air on a cold surface would condense the vapor into dew, fog, rain or snow; on the contrary a warm surface would evaporate water by the conduction of the heat from it to the water. Until it can be shown that the temperature of the air can be controlled by gigantic cooling operations we may look in vain for any alteration in the natural and well established order of events by way of the production of artificial rain.

In ancient times and long before European settlement, trees seem to have flourished in the Oamaru district, for I am told that big roots are still found in the soil, but, except around the old homesteads, the country is now bare of trees. Around their homes the settlers have mostly planted pines which have flourished wonderfully, but if larger and more varied plantations were made, particularly in belts intercepting the northwest and southwest winds, though they might not increase the rainfall yet the trees would act as shelters and windbreaks, and would also conserve the rainfall which now runs off in floods or evaporates in hot, dry weather. Where possible, the planting of deep-rooted rather than surface-rooting trees of a deciduous kind would bring up water from the lower watertables and not only prevent surface evaporation by the winds, but also, as they transpire freely in the summer, create a beneficial humidity in their neighborhood. The excessive heat of a bare, sun-baked soil drives away the rain from a drought-stricken district and thus diminishes the "probability of rain" which otherwise could, from time to time, be reasonably expected. So far as one can see the only objections which can be urged against the planting of trees are the occupation of fertile lands by comparatively unproductive trees and the possible harboring of the small-bird pest. The losses, however, would undoubtedly be more than compensated for by wider general benefits, and the whole question is one of reforestation, which assuredly concerns the community at large, and could with advantage be dealt with by local or general government regulations.

Action with regard to both the planting and destruction of the trees is a matter of vital importance to the country. Whether forest trees increase the rainfall or are themselves the result of an abundant precipitation is not a question I would raise at the present time, but rather considerations of evaporation, shelter, run-off, etc., as affected by tree-planting, and are of more than passing interest to the people of Oamaru.

In conclusion I would like to remark that tho our seasons are usually so temperate, regular, and fruitful, yet climatic variations are of the greatest concern to the country.

30——3

SCHOOLBOYS' WEATHER OBSERVATIONS.

An interesting method of instructing boys in that part of nature study pertaining to the atmosphere has been devised by John Reid, the headmaster of the Reckleford Council School at Yeovil. Each day of the school week several boys are sent to the corporation gas works to copy the records of barometer movements and rainfall there kept, one or two less experienced lads accompanying them. Meantime other boys note the direction of the wind and record the temperature from readings of thermometers hung in the open on the north and south sides of the school. The teacher of the class then enters the particulars on a sheet, and encourages the scholars to make deductions from the collected data. The boys copy the results, and every Friday they write an account of their observations in the form of "general remarks" on the week's weather.—*London Standard.*

The practise of requiring scholars, boys and girls, in the lower school grades to observe, record, and discuss meteorological phenomena was introduced by the Editor into the Normal School at Washington, D. C., in 1882, and has since been tried with great success in all portions of the United States—being heartily supported as an important branch of "Nature Study." The weather maps and forecasts bring the importance of this subject home to the whole community. The above extract from a London paper shows that our science is also being emphasized in the English Public Schools.—*C. A.*

INTERNATIONAL EXCHANGE SERVICE.

Owing to some recent irregularities in the transmission of publications it has occurred to the Editor that possibly many foreign subscribers, exchanges, and recipients of the MONTHLY WEATHER REVIEW are not fully apprised of the workings of the service established by nearly all national governments as an outgrowth and development of the original Smithsonian system. We, therefore, reproduce a circular letter issued by that Institution on behalf of the U. S. International Exchange Service. Any further details desired can be had by addressing the Secretary of the Smithsonian Institution.

In effecting the distribution of its first publications abroad, the Smithsonian Institution established relations with certain foreign scientific societies and libraries, by means of which it was enabled to assist materially institutions and individuals of this country in the transmission of their publications abroad, and also foreign societies and individuals in distributing their publications in the United States.

In recent years the Smithsonian Institution has been recognized by the United States Government as in charge of its official Exchange Bureau, through which the publications authorized by Congress are exchanged for those of other governments; and by a formal treaty it acts as intermediary between the learned bodies and literary and scientific societies of the contracting states for the reception and transmission of their publications.

Attention is called to the fact that this is not a domestic, but an international exchange service, and is used to facilitate exchanges, not within the United States, but between the United States and other countries only. As exchanges from domestic sources for addresses in Hawaii, the Philippine Islands, Porto Rico, Guam, The Canal Zone, and other territory subject to the jurisdiction of the United States do not come within the designation "international," they are not accepted for transmission.

Packages prepared in accordance with the rules enumerated below will be received by the Smithsonian Institution from persons or institutions of learning in the United States and forwarded to their destinations through its own agents, or through the various exchange bureaus in other countries. The Smithsonian agents and these bureaus will likewise receive from correspondents in their countries such publications for addresses in the United States and territories subject to its jurisdiction as may be delivered to them under rules similar to those prescribed herein, and will forward them to Washington, after which the Institution will undertake their distribution.

On the receipt of a consignment from a domestic source it is assigned an "Invoice Number," this number being placed on each package contained in the consignment. A record is then made of the entire list of packages under the sender's name, and the separate packages are entered under the name of the person or office addressed. An account is thus established with every correspondent of the Institution, which shows readily what packages each one has sent or received through the Exchange Service. The books are then packed in boxes with contributions from other senders for the same country, and are forwarded by fast freight to the bureau or agency abroad which has undertaken to distribute exchanges in that country. To Great Britain and Germany, where paid agencies of the Institution are maintained, shipments are made weekly; to all other countries transmissions are made at intervals not exceeding one month.

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The Smithsonian Institution assumes no responsibility in the transmission of packages, and does not solicit contributions for its correspondents, but at all times uses its best endeavors to forward promptly to destination exchanges entrusted to its care.

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1. Packages intended for transmission through the Institution should be addressed "Smithsonian Institution, International Exchanges."

2. The Institution and its agents will not knowingly receive for any address purchased books; apparatus or instruments of any description, whether purchased or presented; nor specimens of any nature except when special permission from the Institution has been obtained, and then only under the following conditions:

(*a*) Specimens in fluid will not be accepted for transmission.

(*b*) Botanical specimens will be transmitted at the rate of 8 cents per pound.

(*c*) All other specimens will be transmitted at the rate of 5 cents per pound.

3. In forwarding exchanges the sender should address a letter to the Institution, stating by what route the consignment is being shipped to Washington, and the number of boxes or parcels of which it is composed.

4. Packages should be legibly addressed, using the language of the country for which they are intended when practicable, and avoiding all abbreviations. When packages are intended for societies and other establishments, names of individuals should be omitted from labels in order to avoid any possible dispute as to ownership.

5. Packages should be securely wrapped in stout paper and, when necessary, tied with strong twine.

6. No package to a single address should exceed one-half of one cubic foot.

7. Letters or other written matter are not permitted in exchange packages.

8. Exchanges must be delivered to the Smithsonian Institution or its agents *with all charges paid*.

9. If donors desire acknowledgments, each package should contain a blank receipt to be signed and returned by the establishment or individual addressed; and if publications are desired in exchange, the fact should be stated on the card or package.

Following is a list of bureaus or agencies through which the distribution of exchanges is effected. Those in the larger and in many of the smaller countries forward to the Smithsonian Institution reciprocal contributions for distribution in the United States.

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Austria: K. K. Statistische Central-Commission, Vienna.
Azores: *via* Portugal.
Barbados: Imperial Department of Agriculture, Bridgetown.
Belgium: Service Belge des Echanges Internationaux, Brussels.
Bermuda: sent by mail.
Bolivia: Oficina Nacional de Inmigración, Estadística y Propaganda Geográfica, La Paz.
Brazil: Serviço de Permutações Internacionaes, Bibliotheca Nacional, Rio de Janeiro.
[1]British Colonies: Crown Agents for the Colonies, London.
British Guiana: Royal Agricultural and Commercial Society, Bridgetown.
British Honduras: Colonial Secretary, Belize.
Bulgaria: Institutions et Bibliothèque Scientifiques de S. A. R. le Prince de Bulgarie, Sofia.
Canada: sent by mail.
Canary Islands: *via* Spain.
Cape Colony: Government Stationery Department, Cape Town.
Chile: Universidad de Chile, Santiago.
China: Zi-ka-wei Observatory, Shanghai.
Colombia: Oficina de Canjes Internacionales y Reparto, Biblioteca Nacional, Bogota.
Costa Rica: Oficina de Depósito y Canje de Publicaciones, San José.
Cuba: sent by mail.
Denmark: Kongelige Danske Videnskabernes Selskab, Copenhagen.
Dutch Guiana: Surinaamsche Koloniale Bibliotheek, Paramaribo.
Ecuador: Ministerio de Relaciones Exteriores, Quito.
Egypt: Director-General, Survey Department, Cairo.
France: Service Français des Echanges Internationaux, Paris.
Friendly Islands: sent by mail.
Germany: Karl W. Hiersemann, Königsstrasse 3, Leipsic.
Great Britain and Ireland: Messrs. William Wesley & Son, 28 Essex street, Strand, London.
Greece: Bibliothèque Nationale, Athens.
Greenland: *via* Denmark.
Guadeloupe: *via* France.
Guatemala: Instituto Nacional de Guatemala, Guatemala.
Guinea: *via* Portugal.
Haiti: Secrétaire d'Etat des Relations Extérieures, Port au Prince.
Honduras: Biblioteca Nacional, Tegucigalpa.
Hungary: Dr. Julius Pikler, Municipal Office of Statistics, City Hall, Budapest.
Iceland: *via* Denmark.
India: India Store Department, India Office, London.
Italy: Ufficio degli Scambi Internazionali, Biblioteca Nazionale Vittorio Emanuele, Rome.
Jamaica: Institute of Jamaica, Kingston.
Japan: Department of Foreign Affairs, Tokyo.
Java: *via* Netherlands.
Korea: shipments temporarily suspended.
Liberia: American Colonization Society, Washington, D. C.
Lourenço Marquez: Government Library, Lourenço Marquez.
Luxemburg: *via* Germany.
Madagascar: *via* France.
Madeira: *via* Portugal.
Mexico: sent by mail.
Mozambique: *via* Portugal.
Natal: Agent-General for Natal, London.
Netherlands: Bureau Scientifique Central Néerlandais, Bibliothèque de l'Université, Leyden.
Newfoundland: sent by mail.
New Guinea: *via* Netherlands.
New Hebrides: sent by mail.
New South Wales: Board for International Exchanges, Public Library, Sydney.
New Zealand: Colonial Museum, Wellington.
Nicaragua: Ministerio de Relaciones Exteriores, Managua.
Norway: Kongelige Norske Frederiks Universitet Bibliotheket, Christiania.
Paraguay: Ministerio de Relaciones Exteriores, Asuncion.
Persia: Board of Foreign Missions of the Presbyterian Church, New York City.
Peru: Oficina de Reparto, Depósito y Canje Internacional de Publicaciones, Ministerio de Fomento, Lima.
Portugal: Serviço de Permutações Internacionaes, Bibliotheca Nacional, Lisbon.
Queensland: Board of Exchanges, Brisbane.
Roumania: *via* Germany.
Russia: Commission Russe des Echanges Internationaux, Bibliothèque Impériale Publique, St. Petersburg.
Saint Christopher: sent by mail.
Salvador: Museo Nacional, San Salvador.
Santo Domingo: sent by mail.
Servia: *via* Germany.
Siam: Minister for Foreign Affairs, Bangkok.
South Australia: Public Library of South Australia, Adelaide.
Spain: Depósito de Libros, Cambio Internacional y Biblioteca General del Ministerio de Instrucción Pública y Bellas Artes, Madrid.
Sumatra: *via* Netherlands.
Sweden: Kongliga Svenska Vetenskaps Akademien, Stockholm.
Switzerland: Service des Echanges Internationaux, Bibliothèque Fédérale Centrale, Bern.
Syria: Board of Foreign Missions of the Presbyterian Church, New York.
Tasmania: Royal Society of Tasmania, Hobart.
Transvaal: Government Library, Pretoria.
Trinidad: Victoria Institute, Port of Spain.
Tunis: *via* France.
Turkey: American Board of Commissioners for Foreign Missions, Boston.
United States of America: Smithsonian Institution, Washington, D. C.
Uruguay: Oficina de Depósito, Reparto y Canje Internacional, Montevideo.
Venezuela: Biblioteca Nacional, Caracas.
Victoria: Public Library of Victoria, Melbourne.
Western Australia: Public Library of Western Australia, Perth.
Zanzibar: sent by mail.

WASHINGTON, D. C., *February 1, 1908*.

[1]This method is employed for communicating with several of the British Colonies with which no medium is available for forwarding exchanges direct.

WATERSPOUT AT BEAUFORT, N. C.

By BARTGIS MCGLONE, Ph. D. Dated Beaufort, N. C., July 4, 1908.

During the passage of a squall from southeast to northeast, on Thursday afternoon, July 2, 1908, two waterspouts formed. The coast here at Beaufort, N. C. extends east and west. The

laboratory is situated about 1½ miles from the inlet on an island.

The second spout was very interesting in as much as a hollow cone could be observed. To describe this in detail: A very slender cone descended from the general cloud mass, nearer and nearer to the waves. Then from the ocean a mist appeared, this was cylindrical in shape and of much greater diameter than the cloud mass. The conical cloud mass and the cylindrical mist met. The breaking up of the spout started with the disjunction of the cloud and mist and the absorption of the cone into the general cloud mass. After the spout broke, and as the cone ascended, protrusions formed at two points on the spout. As the phenomenon was at least 5 miles distant I could not secure more accurate information.

A few years ago a waterspout crost the harbor near the laboratory, but I was not an observer.

AUSTRALIAN WEATHER.

By DAVID J. MARES, Meteorologist. Dated Sydney, N. S. W., January 15, 1908.
[Reprinted from the Sydney Morning Herald of January 15, 1908.]

The lines drawn over the map are isobars, or lines of equal barometric pressure. The telegrams received during the course of a day by the meteorologist consist of a variety of data from the chief towns of the Commonwealth, and comprise chiefly the 9 a. m. readings of the barometer, temperature, wind, and weather. These are plotted in their respective positions on the chart, with symbols to denote the character of the wind and weather, and figures to show the readings of the barometer and temperature.

When all the barometer readings are plotted, lines are drawn through those stations reporting equal barometric pressure. Thus we obtain various shapes, and the highest values constitute the high pressure, and the lowest readings the low pressure, as shown on the weather map; an area of low pressure being always located between two highs.

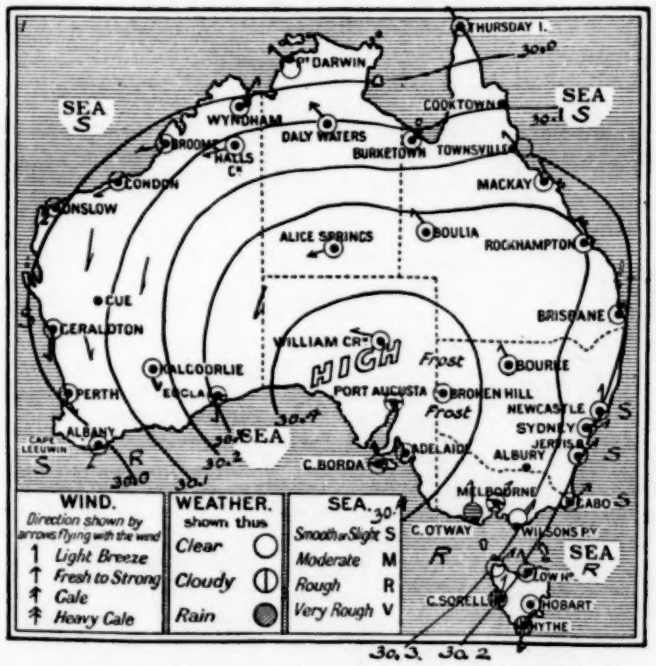

FIG. 1.—Winter anticyclones or high pressures. A type showing Australia under anticyclonic control and fine-weather conditions.

The low pressures, depressions, or cyclones, as they are variously termed, are the exact converse of the "highs" as regards weather features; for whereas in the "high" the greatest readings are in the center, in the depressions the smallest readings are found there. The high pressures or

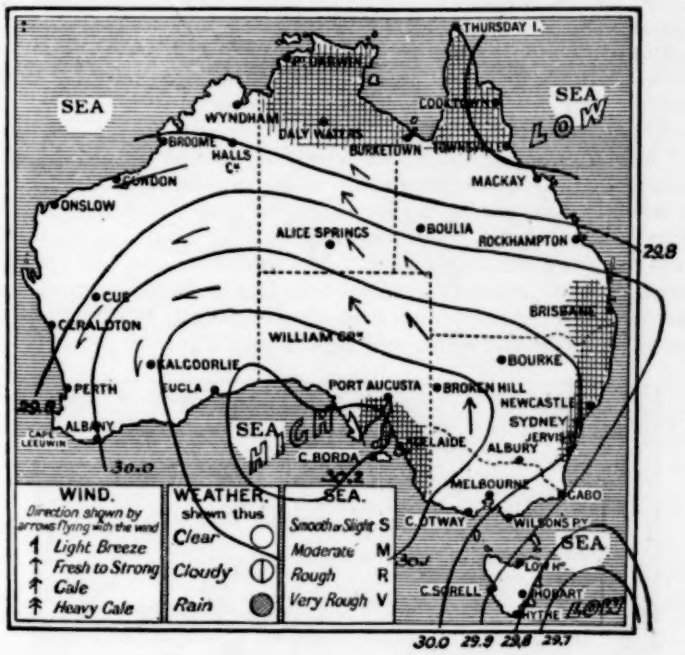

FIG. 2.—Summer anticyclones. These usually put in an appearance at about Albany, and thence travel eastward.

There are certain marked characteristics in these two types of pressure as regards wind and weather. In the "high" which has the greatest pressure in the center, the winds blow spirally outward, and as a rule its presence is associated with fine, dry weather in summer, and fine weather, with fogs, frosts, and dews, in winter.

anticyclones, as they are sometimes termed, enter Australia on the west coast at about Geraldton in winter (see fig. 1); and on the average near Albany in the southwest in summer (see fig. 2). They travel from west to east at an average rate of about 400 miles per day, and in due course pass over the eastern coast, so that they control the weather of the land sur-

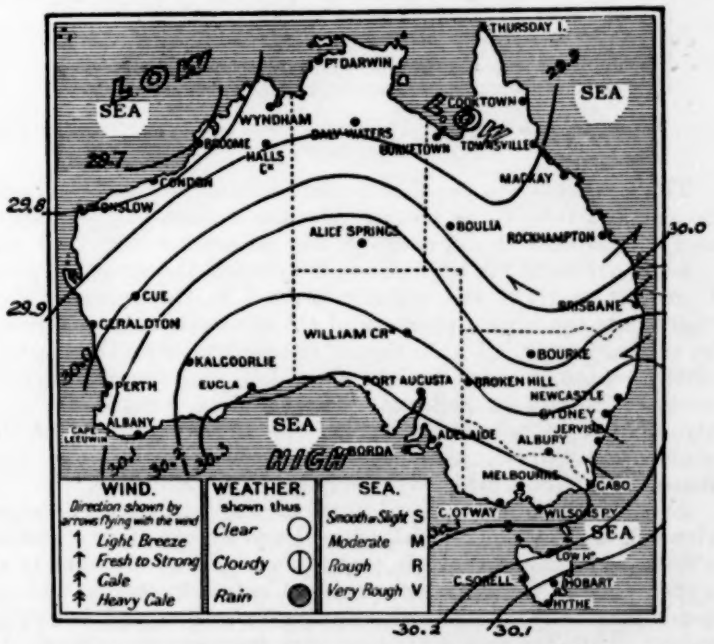

FIG. 3.—Anticyclone favoring coastal and highland rainfall. This type may be considered as a rain producer in both summer and winter.

faces which they traverse for about five days. On rare occasions this velocity of movement exceeds 1,000 miles per day, while at other times it decreases almost to stagnation.

Fine weather with cloudless skies is the almost invariable result of the influence of their presence, owing probably to the fact that the relatively high barometer readings of the center are dependent on the descent from above of cold, dry, heavy air, which is transferred over a considerable extent of country by the outward tendency of the wind. This ensures dry conditions over the area occupied by the high pressure.

An anticyclone measures in area anywhere from one to three million square miles. The winds on their northern, southern, eastern, and western sides blow from east, west, south, and north, respectively.

Under favorable circumstances, however, as when the high pressure centers are traveling along the southern coast, the advance isobars, owing to the influence they exert on the directions of the winds, favor the importation inland of moisture from the surrounding ocean. The moisture, on reaching the eastern slopes of the Great Dividing Range, is forced to ascend, and in so doing condenses into cloud and rainfall between the mountains and the coast (see figs. 2 and 3).

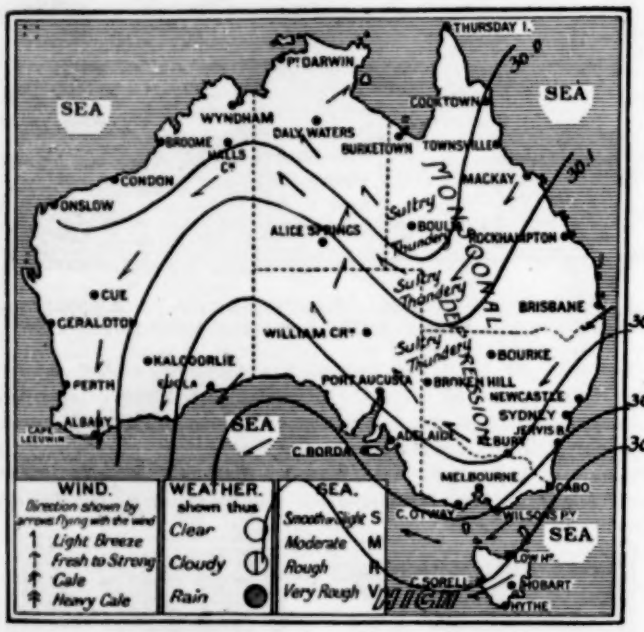

FIG. 4.—Monsoonal depression. Disturbances of this nature cause very good rains.

The low pressures peculiar to the mainland of Australia may be divided into three classes, viz, the monsoonal, Λ-shaped, and closed-curved depressions. In character they are the exact converse of the high pressure systems, the winds blowing from left to right and spirally inward to the center, which represents the lowest pressure of the atmosphere as measured by the barometer. Unlike that of the anticyclones, the weather in the center of the "low" is close, hot, and muggy, and invariably cloudy or raining. These sultry conditions favor strong ascensional currents into the higher regions of the atmosphere, which upon cooling down with altitude condenses into cloud, which is precipitated as rainfall.

From September to April some of the best rainfalls experienced in New South Wales are the products of depressions chiefly of monsoonal origin (see fig. 4). These first put in an appearance in the northern part of Central Australia, and extend gradually southward, causing extensive and beneficial rains. Thunder also is another very frequent occurrence.

The second class of depression is the Λ-shaped which is an intrusive low pressure peculiar to the southern portion of the continent between two high pressures. This type (see fig. 5) is not essentially a rain developer, owing to its shape, which is open on the southern part. The winds on the eastern or advancing side are from the northwest; in summer, the hot, dusty, dry northwesters so often experienced in New South Wales. On the western side of this depression is the cool, welcome southerly "burster." This explains the reason why a hot northerly wind is so quickly followed by a cool southerly. For as soon as the center of the Λ passes a certain point the wind from an opposite direction is experienced.

The third depression (see fig. 8) is the closed curve, of cyclonic nature. Its shape is annular or rounded, the winds as a rule being very violent, and, as it passes over the seaboard, proves very dangerous to shipping, for it very soon lashes up the sea with its hurricane-like easterly squalls. The directions of the winds on its northern, southern, eastern, and western sides are west, east, north, and south, respectively. Very heavy rains are, as a rule, experienced with this class of disturbance, and certain types of this order of low pressure are quite destructive, but fortunately their appearance is very rare.

The following detailed explanation of the accompanying charts will prove helpful:

A winter anticyclone, fig. 1, has been described in the foregoing as making its first appearance on the western shores of Australia, at about Geraldton, thence traveling eastward over the mainland at a variable rate, but averaging about 400 miles per day. As a further explanation, it should be stated that the shape of the anticyclone over the comparatively flat lands of the continent is an ellipse, with axes in the ratio of two to one, the longer axis being east and west. This shape is somewhat modified when the high pressure reaches the Great Dividing Range, the result being a deflection of the whole anticyclone to the north. The usual weather conditions associated with it are fine during the day, with early morning frosts and fogs. Figure 1 shows an illustration of an anticyclone, which, owing to the disposition and extent of its isobars, controlled the weather of the whole continent.

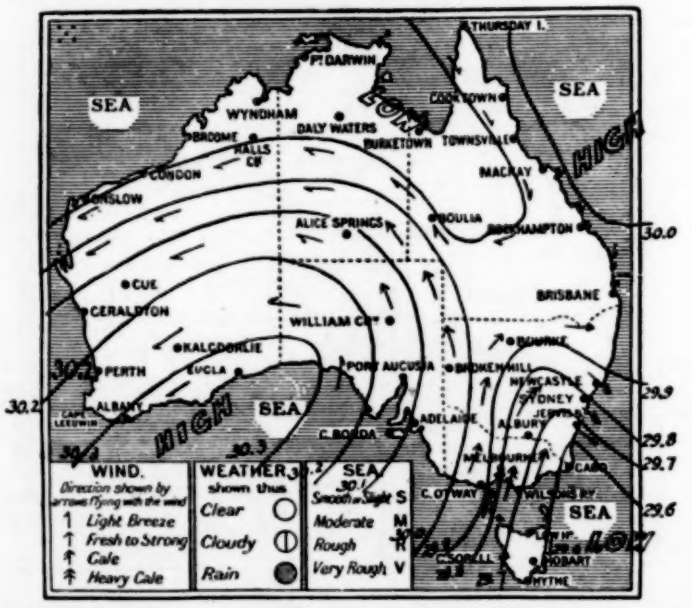

FIG. 5.—Λ-shaped depression. Showing the frontal portion of the Λ responsible for the hot nor'-westers, passing off the coast of New South Wales, and the southerly gale, or "burster," which is imminent, approaching the seaboard.

Figure 2 is a type of the summer anticyclone. The high pressure, peculiar to the summer months, travels in higher latitudes, or farther south, than that of winter, the variation in latitude being influenced by the migrations of the sun. On the average, they first put in an appearance at about Albany, W. A., and thence travel eastward, but do not control our weather to such an extent as the winter types, for their more southern latitude induces the development of the monsoonal

disturbances to the north. The winds on the eastern or advance side of this high pressure are from the south, and on the western limits blow from the north.

Figure 3 is a representation of another anticyclone, but with opposite weather characteristics, which are probably due, in addition to its comparatively high or southern latitude of

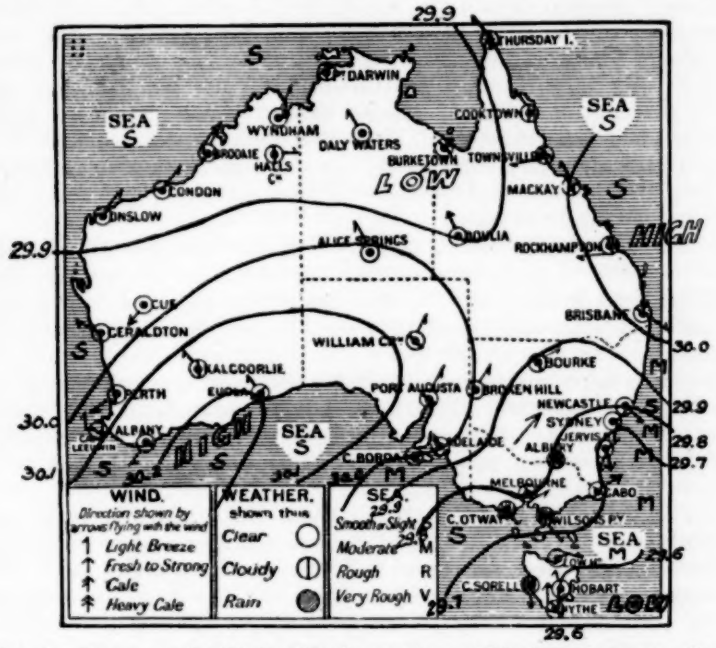

FIG. 6.—Square or double-headed depression. This type is responsible for development of thunder and hail conditions.

travel, to the peculiar distribution of its isobars. These are so situated as to influence the sea breezes to blow toward our eastern slopes, where their moisture is precipitated as rainfall.

As shown in fig. 4, a monsoonal depression covers the whole of the eastern States, with its isobars so arranged as to influence the importation inland of moisture from the ocean on the east. In each case—from the isobar of 30.00 inches to that of 30.4 inches—the winds are from the northeast, east, and southeast in the depression, which acts in the capacity of a basin, and collects the moisture thus brought in. This moisture is essential to the development of thunder and rainfall. Disturbances of this nature cause very good beneficial rains which are occasionally distributed over the entire State, particularly between the months of September and April.

Λ-SHAPED DEPRESSION.

The Λ-shaped depression mentioned in the foregoing is formed between two high pressures. A good example of one is shown in fig. 5. The winds associated with this class of low pressure are worthy of remark, for near the apex of the Λ a very narrow division exists between the hot nor'-wester, on its eastern side (which in this instance is just passing seaward), and the cool southerly burster on the western side. A glance at the figure will show this very clearly. Under certain conditions, although not essentially a rain producer, some fairly good rains from the thunderstorms may be occasioned by a Λ; for the region between two high pressures is, as a rule, associated with thundery conditions, which are at times accentuated by the proximity of the depression.

The isobaric contour shown in fig. 6, represents to the forecaster a very reliable indication of thunder and hailstorms. It is really a subtype of the Λ depression, and, owing to its shape, is styled "square or double-headed." This peculiar formation is due to the expansion of the apex of the Λ. Probably this results from the geographical features between South Australia and our southeast coast, as also from the fact that during the previous day the outer isobar extended into very low latitudes, thus favoring the transportation southward by its northerly winds, of the sultry, unsettled conditions which obtained in the northern part of Central Australia. These conditions become the dominant weather features about the central area of the depression, and result in both thunder and hail over many parts of the state. The pressure distribution, as shown in fig. 6, is identical with that on the weather maps of November 23 and 26, 1907, and caused the phenomenally heavy thunder and hailstorms on those dates.

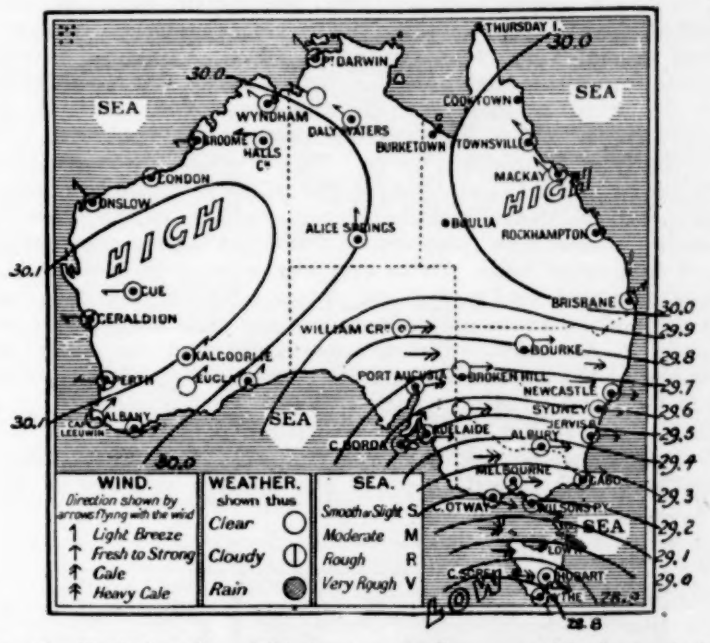

FIG. 7.—Westerly gales. This type, generally responsible for westerly gales over a great expanse of country, occurs chiefly in the winter months.

The subtype which is generally responsible for westerly gales over a great expanse of country, is shown in fig. 7. It occurs chiefly in the winter months.

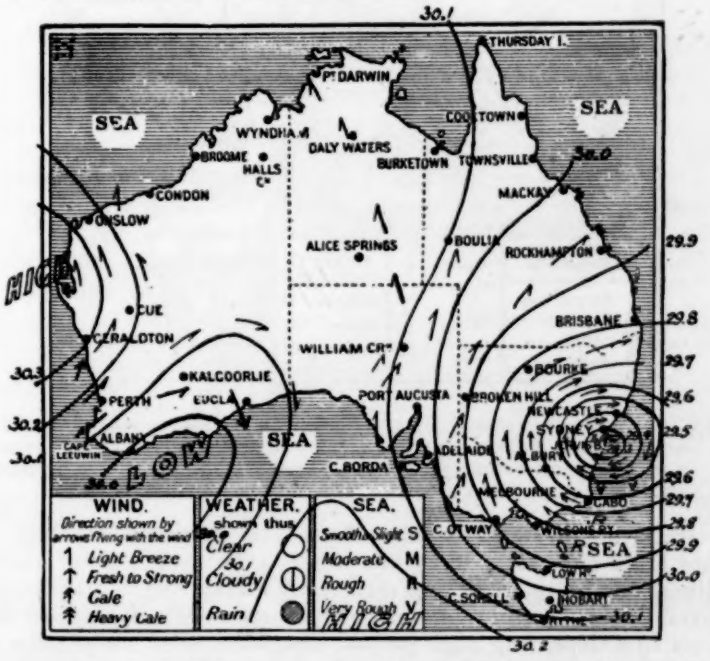

FIG. 8.—A cyclonic disturbance. This type shows an energetic cyclonic disturbance situated over the eastern States, with its center (29.3) between Jervis Bay and Sydney.

In this example the Λ flattens out considerably, until its isobars run almost east and west, and crowd together, making

the barometric gradient very steep. Sometimes between the lowest and the highest readings there is a range in pressure of upward of 1 inch in about 1,000 miles, which causes very heavy westerly gales over the country covered by the low pressure, especially near the area of lowest barometric readings. With a disturbance of this description, light to heavy general rains are experienced over South Australia, Victoria, and the southern half of New South Wales.

Figure 8, shows a remarkable distribution of pressure in New South Wales, with a central barometric value of 29.3 inches, and its surrounding isobars very closely arranged; thus causing very steep gradients and, consequently, violent winds round the vortex of the disturbance. The circulation of the wind is clockwise, the directions being west on the northern, north on the eastern, east on the southern, and southerly on its western limits. This is popularly known as a "cyclone", and the violence of the winds is perilous to shipping, especially the easterly element, which, as the storm is leaving a coast line, as shown on the chart, causes very rough and dangerous seas. Some very heavy rains occur over the area occupied by the cyclone, at times causing floods in low lying lands. These cyclonic storms are very seldom experienced in Australia. On rare occasions, however, they are formed at the southern extremity of a monsoonal tongue, and now and then a roving "cyclone" may work southward from the Tropics, to Rockhampton or Brisbane. In the latter case their appearance would be almost unheralded, until the strong southerly and easterly gales of the western side are in full swing.

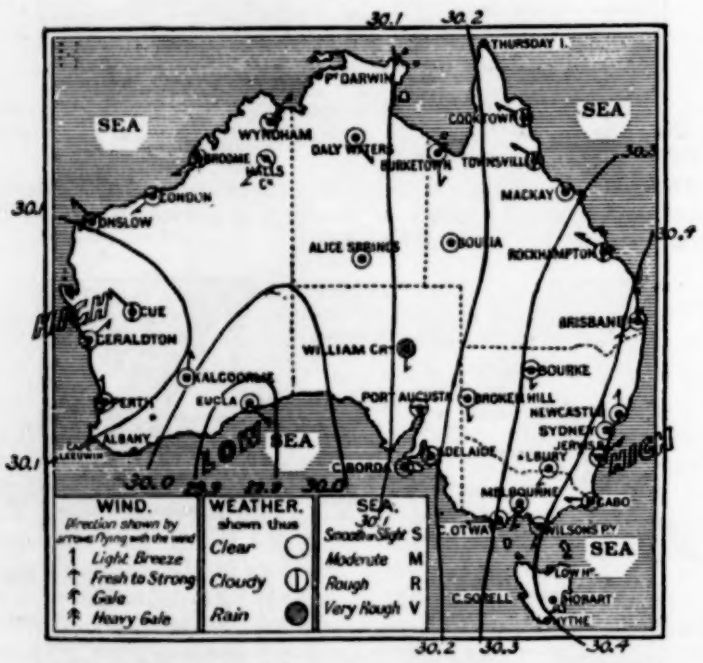

Fig. 9.—Vertical or straight line isobars. These isobars over the eastern states, closely followed by a Λ-shaped depression, sometimes result in good general rains over the southeastern states within forty-eight hours.

Figure 9, presents a class of pressure distribution which is not often met with, but when it exists, as here shown, sometimes results in good general rains within forty-eight hours over the southeastern states. The north-south isobars are the rear of a departing high pressure, and the wind circulation is responsible for the inflow to the heart of the continent, of tropical moisture which, upon being met by the cool southerly wind of the Λ-shaped depression, is precipitated as rainfall. These resulting rains occur first in the northwest of our state, thence extend eastward and finally westward.

NOTES FROM THE WEATHER BUREAU LIBRARY.

By C. FITZHUGH TALMAN, Librarian.

INAUGURATION OF THE LAKE CONSTANCE KITE STATION.

Altho regular observations were begun at the Lake Constance kite station on April 1, 1908 (see MONTHLY WEATHER REVIEW, February, 1908, p. 21, and April, 1908, p. 110), the formal inauguration of the building took place July 11, in the presence of the King of Württemberg, representatives of the German Empire, Baden, Bavaria and Alsace–Lorraine, the governing board of the institution, and certain members of the International Committee on Scientific Aeronautics. This event has attracted much attention to the new station, descriptions of which have lately appeared in many of the European newspapers, and popular illustrated weeklies, as well as in the scientific press.

The institution owes its origin chiefly to Professor Hergesell, of Strassburg, president of the International Committee on Scientific Aeronautics. As early as 1900 Professor Hergesell made experimental kite flights over Lake Constance, in collaboration with Count Zeppelin; and having assured himself that this lake was especially well suited for the operations of a kite boat he brought the matter to the attention of the German Imperial and State governments, and succeeded in obtaining the necessary appropriations for the establishment and maintenance of the station.

The little steamer *Gna*, from which the kites are flown, resembles a torpedo boat and has a maximum speed of 19½ knots. The kites are launched from the masthead, and are generally flown tandem. It is said that the four members of the crew are becoming quite expert in the difficult and unique task of adapting the speed and direction of their vessel to the vagaries of the wind.

DOCTOR POLIS'S SECOND VISIT TO AMERICA.

Dr. P. Polis, Director of the Meteorological Observatory of Aachen, Germany, arrived in New York on the *Kaiserin Auguste Victoria* August 15, and sailed for Germany on the same steamer August 20. Doctor Polis's trip was undertaken at the invitation of the Hamburg-American Line, in order that he might make experimental daily weather maps of the transatlantic steamship route, based on wireless reports from steamers and land stations. A report of the results of the journey will be made to the German Government.

METEOROLOGY IN BRITISH NORTH BORNEO.

We are indebted to Mr. Lester Maynard, American Consul at Sandakan, British North Borneo, for an extract from the British North Borneo Herald of July 1, 1908, regarding the meteorological work that is now carried on in that country under the supervision of the principal medical officer. It appears that the latter official has just published a small pamphlet, not intended for general circulation, containing the somewhat imperfect results of the observations made at all stations during 1906 and 1907, which is believed to be "the first attempt to collate the meteorological returns of the various stations in North Borneo."

To the following abstract of the annual rainfall is attached the query: "Is Tawao the Sahara of British North Borneo, or is it only the result of a leaky rain-gage?"

TABLE 1.—*Annual rainfall in British North Borneo, 1906–7.*

	1906.	1907.
	Inches.	*Inches.*
Sandakan	84.48	153.74
Kudat	64.16	101.70
Taratipan (near Kudat)	99.14	104.59
Jesselton	94.63	101.96
Beaufort	158.09	(?) 62.91
British Borneo Para Rubber Co., Beaufort	159.03	168.64
Sapong Estate	64.80	57.10
Tawao	28.33	26.39

Taking the year 1906, December was the wettest month in Sandakan, Kudat, and Taritipan, the rainfall being respectively 29.00, 27.16, and 29.23 inches, while in Jesselton, Beaufort, and the British Borneo Para Rubber Estate (Beaufort) the most rain was registered as follows: Jesselton, August, 22.37; Beaufort, August, 27.15; Beaufort, April, 28.70 (?); British Borneo Para Rubber Estate (Beaufort), July, 23.30; British Borneo Para Rubber Estate (Beaufort), August, 21.48.

In 1907 Sandakan recorded 34.54 inches in February and 24.87 in March, December being comparatively dry with 16.96, while Kudat's rainiest month was March, with 22.51, Taritipan showing 27.14 for the same period. On the other hand, these months were amongst the driest on the west coast, Jesselton not reaching double figures till June and July with 11.45 and 12.96 inches, while the British Borneo Para Rubber Company's Estate, Beaufort (the hospital returns for that station being probably unreliable), show an average of 10 to 14 inches for every month thruout the year, with the exception of August (7.68), October (25.29), and December) 19.33).

BRILLIANT SKY GLOWS.

From many parts of middle and northern Europe and the British Isles come reports of a brilliant illumination of the northern sky during the night of June 30–July 1, 1908, and less conspicuous displays of a similar character on other nights preceding and following that date. Nature (London) of July 9 reports that the whole of the northern part of the sky, from the horizon to an altitude of about 45° and extending to the west, was suffused with a reddish hue, the color varying from pink to an Indian red. Several observers state that it was possible to read fairly small print at midnight without any aid from artificial light.

Ciel et Terre (Brussels) reports that in Belgium the illumination, which extended horizontally over an arc of about 90°, did not rise to more than from 5° to 10° above the horizon, tho its reflection extended more or less over the whole sky. It was of an intense golden yellow above and a pronounced red below, presenting somewhat the aspect of the eastern sky a few moments before sunrise. The region of maximum illumination moved slowly toward the east, apparently following the movement of the sun; at midnight it was due north.

All the accounts of the illumination agree that it presented none of the characteristic features of an aurora, but was probably due to the presence of dust (or, as T. W. Backhouse, in Nature of August 20, says, "some substance") at such a height in the atmosphere that the sun shone upon and illuminated it when far below the horizon of the observer. In this connection American readers should remember that in northern Europe around the time of the summer solstice the sun is never far enough below the horizon to put an end altogether to the twilight, under average conditions of the atmosphere.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Librarian.

The following have been selected from among the titles of books recently received, as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies. Most of them can be lent for a limited time to officials and employees who make application for them. Anonymous publications are indicated by a ——.

Aachen. Meteorologisches Observatorium.
Niederschlagskarte der Rheinprovinz nebst den angrenzenden Teilen von Hessen-Nassau und Westfalen. 1894–1903. Essen. n. d. 1 sheet. 123 x 191 cm.
Erläuternder Text zur Niederschlagskarte der Rheinprovinz ... von P. Polis. Essen. 1908. 34 p. 4°.
Temperaturkarte der Rheinprovinz nebst den angrenzenden Teilen von Hessen-Nassau und Westfalen. Auf Grund zwanzigjähriger Beobachtungen 1881–1900. Essen. n. d. 2 sheets. 68 x 118 cm.
Erläuternder Text zur Temperaturkarte der Rheinprovinz ... von P. Polis. Essen. 1905. 20 p. 4°.

Australia. Commonwealth bureau of meteorology.
The climate and meteorology of Australia. Bull. no. 1 ... by H. A. Hunt. Melbourne. [1908.] 34 p. 8°.

Austria-Hungary. Hydrographisches Amt der K. und k. Kriegsmarine in Pola.
Jahrbuch der meteorologischen, erdmagnetischen und seismischen Beobachtungen. Neue Folge. 12. Band. Pola. 1908. xxiv, 152p. f°.

British Guiana. Botanic gardens, Georgetown.
Meteorological observations. n. t. p. HH 23 p. f°.

Curityba (Brazil). Observatorio meteorologico de Curityba.
Taboa de clima de Curityba. Valores normaes extremos e totaes obtidos pelas observaçoes feitas durante 23¾ de annos, de maio de 1884 a dezembro de 1907 ... Curityba. 1908. 1 sheet. 33 x 43 cm.
Resumo das observaçoes feitas durante o anno de 1907. Curityba. 1908. 1 sheet. 32 x 41 cm.

France. Bureau central météorologique.
Annales. Année 1905. II. Observations. Paris. 1908. v. p. f°.
Same. Année 1905. III. Pluies. Paris. 1907. v. p. f°.

Great Britain. Meteorological office.
Barometric gradient and wind force. Report to the director of the Meteorological office on the calculation of wind velocity from pressure distribution and on the variation of meteorological elements with altitude. By Ernest Gold. London. 1908. 44 p. f°.
Hourly readings obtained from the self-recording instruments at four observatories ... 1907. London. 1908. xvii, 197 p. f°.

Liverpool observatory.
Report of the director of the observatory to the Marine committee... Liverpool. 1908. 43 p. 8°.

Mauritius. Royal Alfred observatory.
Results of the magnetical and meteorological observations ... 1906. London. 1908. xxx (lxxv) p. f°.

Montevideo. Colegio Pio de Villa Colon. Observatorio meteorologico.
Años meteorológicos 1902–3, 1903–4 y 1904–5. Montevideo. 1907. 16 p. f°.

Netherlands. Koninklijk nederlandsch meteorologisch institut.
Observations océanographiques et météorologiques dans l'océan Indien. Septembre, octobre, novembre (1856–1904). Utrecht. 1908. xiii, 190 p. f°.

Prussia. Landesanstalt für Gewässerkunde.
Jahrbuch für die Gewässerkunde Norddeutschlands. Besondere Mitteilungen. Band 1 (Heft 2). Berlin. 1907. vi, 101 (25) p. f°.
Same. Band 2 (Heft 1). Berlin. 1907. 96 p. f°.

U. S. Philippine commission.
Report. 1907. 3 parts. Washington. 1908. 8°.

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

C. FITZHUGH TALMAN, Librarian.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——

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—— The work of a Nebraska cyclone. p. 78. (August 1.)
Cummings, Edith E. A young girl's theory of thunderstorms. p. 123. (August 22.)

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LeConte, Joseph N. Snowfall in the Sierra Nevadas. p. 310–314.

Telegraph age. New York. v. 25. August 1, 1908.
Willey, Day Allen. Electricity in the United States Weather Bureau. p. 513–515.

Geographical journal. London. v. 32. July, 1908.
Mill, Hugh Robert. The geographical distribution of rainfall in the British Isles. p. 59–65.
E., J. W. South American rainfall. p. 76–77. [Review of work by Voss.]

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Chree, C. The isothermal layer of the atmosphere. p. 293.

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Esclangon, Ernest. Sur les variations de la durée du crépuscule. p. 27–29. (6 juillet.)
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Knörzer, A. Ueber die Temperaturverhältnisse der oberrheinischen Tiefebene. p. 372–396.
Meteorologische Zeitschrift. Braunschweig. 25. Band. Juni, 1908.
Maurer, J. Die Wärmeabnahme mit der Höhe in den Schweizer Alpen. p. 241–246.
Michelson, W. A. Ein neues Aktinometer. p. 246–253.
Hann, J[ulius]. H. Mohn über die meteorologische Ergebnisse der zweiten norwegischen arktischen Expedition im "Fram," 1898 bis 1902. p. 256–259.
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Schmauss, A. Die Temperatur der unteren Schichten der freien Atmosphäre über München am 2., 3. und 4. Januar 1908. p. 263–267.
—— Untersuchungen über die Veränderlichkeit der jährlichen Niederschlagsperiode im Gebiete zwischen der Donau und nördlichen Adria. p. 274–275.
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—— Zum Klima des Französischen Sudan. Oberes Senegambien p. 284.
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Gellhorn, O. von. Leuchtende Nachtwolken? (1 Juli.) p. 291–292.
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Knoch, Karl. Die Entwicklung unserer Kenntniss des Windschutzes bei der Aufstellung der Regenmesser. (Juni, Juli.) p. 129–131; 151–158.
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Schulze, Paul. Ludwig Friedrich Kämtz. (Juli.) p. 145–151.
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THE WEATHER OF THE MONTH.

By Mr. P. C. DAY, Acting Chief, Climatological Division.

PRESSURE AND WINDS.

The distribution of mean atmospheric pressure for July, 1908, over the United States and Canada, is graphically shown on Chart VI, and the average values and departures from the normal are shown for each station in Tables I and III.

There was a marked rise in pressure from that of June, 1908, over all portions of the United States and Canada, except along the coast of California and Oregon and a small area over the lower Lake region. The increase over the Great Plains and Rocky Mountain districts was unusual for the season, ranging from 0.10 to 0.26 inch.

The average pressure for the month was above normal over all districts, except a small area in northern California. Over the central Rocky Mountain region the pressure averaged more than 0.1 inch above normal, while over nearly all the remaining districts of the United States and Canada there was a rather uniform positive departure of from .05 to .08 inch.

Southerly and southwesterly winds prevailed over most of the districts east of the Rocky Mountains and also generally over the southern Plateau, while along the immediate Pacific coast they were mostly from the northwest.

There was a marked absence of high winds, and the average hourly movement was below the normal over nearly all districts, except along the immediate Atlantic coast where there was an excess ranging from 10 to 40 per cent.

TEMPERATURE.

The mean temperature for the month was below the normal over the southern portion of the Gulf States and from the middle Mississippi Valley westward to the Rocky Mountains and southward to the Mexican border, except over a small portion of southern Texas. There was a small deficiency also along the immediate Pacific coast and at points in western Virginia.

Over the Atlantic coast districts and from New England westward over the Lake region to the Dakotas, and generally over the Rocky Mountains, Plateau, and Pacific coast districts, the mean temperature was above the normal, being especially high over central and northern California, Oregon, and eastern Washington, and the surrounding portions of Idaho and Nevada, where the positive departures ranged from 3° to 5° per day.

Maximum temperatures ranged from 90° to 98° over most districts east of the Rocky Mountains, except in the upper Missouri Valley, where they reached 100° or slightly higher. In the interior valleys of California, over southern Arizona, and in the lower Rio Grande Valley, they ranged from 100° to 114°.

Minimum temperatures below 40° were recorded in northern New England, along the northern border from the upper Michigan Peninsula to northern Washington, and generally over the Rocky Mountain districts from New Mexico northward. Temperatures of 32° or slightly lower occurred at a few points along the Main Divide from central Colorado to the Canadian border.

PRECIPITATION.

The distribution of precipitation during July, 1908, is graphically shown on Chart IV by appropriate shading or by figures representing the actual amount of fall over districts, the topography of which is too varied to admit of approximately correct shading.

The monthly amounts of precipitation east of the Rocky Mountains ranged generally from 2 to 4 inches, with somewhat larger amounts over portions of the lower Missouri Valley, in northern Texas, and portions of Oklahoma and Arkansas, and generally over the Gulf and South Atlantic States, where the average ranged from 4 to 6 inches, with local falls of more than 10 inches in eastern Texas, the southern portions of Louisiana and Mississippi, northern Florida, and eastern North Carolina.

Comparatively heavy rains for the region, 2 to 5 inches, occurred over the greater part of Arizona and New Mexico and

the southern portions of Utah and Colorado. West of the Rocky Mountains the rainfall was generally less than 1 inch, and over the greater part of California no rain occurred during the month.

Precipitation was above the normal along the Atlantic coast from southern New England to North Carolina, over the Appalachian Mountain region from central Pennsylvania southward, and over the west Gulf States to eastern Texas. There was also an excess over the Panhandle of Texas, northern New Mexico, and from Arizona northwestward over the Plateau districts to eastern Oregon and Washington, as well as along a narrow strip from central Colorado northeastward thru central Nebraska to northeastern Iowa.

There was a general deficiency in precipitation over northern New England, the Lake region, Ohio, Mississippi, and upper Missouri valleys, along the entire Pacific coast, and over the east Gulf States.

The drought that had prevailed during the latter part of June over New England and the northern portion of the Middle Atlantic States, was generally broken during the latter half of July, but the need of more rain was again felt at the end of the month, over portions of the Lake region and Ohio Valley.

HUMIDITY AND SUNSHINE.

Average relative humidity above the normal for July was the rule over nearly all portions of the United States, the only exceptions being small areas along the Atlantic coast from Virginia to New England, over the lower Mississippi Valley, in North Dakota, and in portions of central California and western Oregon. Over the Great Plains, Rocky Mountain, and Plateau districts there was a uniform excess of from 5 to 15 per cent.

Much clear weather prevailed from New England westward over the Lake region and upper Mississippi and Missouri valleys, where the amounts ranged generally above 60 per cent of the possible.

Over the interior of California and generally over the northern Plateau district, the sunshine was the above the normal, ranging from 75 to 95 per cent of the possible. Sunshine was also above the average over the western portion of Missouri and Arkansas and the eastern portions of Kansas and Oklahoma.

Much cloudy weather prevailed over the South Atlantic and Gulf States, western Texas, and the southern portions of the Rocky Mountain and Plateau regions.

WEATHER IN ALASKA.

Seasonable temperatures appear to have prevailed, the extremes ranging from 37° and 83° in the southern coast districts, to 32° and 89° in the interior. Rainfall was comparatively heavy over the southern coast, diminishing northward. It ranged from about 5 inches at Calder, in the extreme south, to less than 1 inch at Fort Gibbon, in the central part of the Territory, and near the Arctic Circle. Much cloudy weather prevailed over the southern coast, but in the interior clouds and sunshine alternated at frequent intervals.

In Canada.—Director R. F. Stupart says:

The mean temperature of July was above normal thruout the greater portion of Canada. A normal or slightly subnormal value, however, was recorded in eastern Saskatchewan, the greater portion of Manitoba, and the Rainy River and Thunder Bay districts of Ontario.

The precipitation during July in Canada was very generally less than the average, and this was particularly the case in the Western Provinces, and especially in southern Saskatchewan, where the total amount was but 26 per cent of the average. Marked deficiencies also occurred in New Ontario and northern New Brunswick. Some few localities in northern Manitoba, central Ontario, and southern Nova Scotia reported a slight excess, generally due to thunderstorms of a very local character.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	12	71.0	+ 2.1	+ 5.0	+ 0.7
Middle Atlantic	16	75.8	+ 1.2	+ 2.2	+ 0.3
South Atlantic	10	79.1	+ 0.2	+ 8.2	+ 1.2
Florida Peninsula*	8	81.6	— 0.2	+ 7.5	+ 1.1
East Gulf	11	80.1	— 0.2	+ 8.6	+ 1.2
West Gulf	10	80.8	— 1.0	+12.7	+ 1.8
Ohio Valley and Tennessee	13	77.1	+ 0.3	+ 8.3	+ 1.2
Lower Lake	10	71.8	+ 0.3	+ 2.9	+ 0.4
Upper Lake	12	68.4	+ 0.6	+10.0	+ 1.4
North Dakota*	9	68.9	+ 0.6	+20.1	+ 2.9
Upper Mississippi Valley	15	74.5	— 0.9	+10.3	+ 1.5
Missouri Valley	12	74.2	— 1.5	+16.8	+ 2.4
Northern Slope	9	68.5	+ 0.4	+ 9.1	+ 1.3
Middle Slope	6	74.3	— 2.3	+14.3	+ 2.0
Southern Slope*	7	77.1	— 3.2	+ 8.8	+ 1.3
Southern Plateau*	12	79.2	— 0.2	— 1.0	— 0.1
Middle Plateau*	10	72.2	+ 0.9	— 2.1	— 0.3
Northern Plateau*	12	71.0	+ 2.6	+ 5.3	+ 0.8
North Pacific	7	62.4	+ 1.2	+ 0.3	0.0
Middle Pacific	8	68.6	+ 1.8	+ 0.4	+ 0.1
South Pacific	4	71.9	+ 2.0	+ 3.2	+ 0.5

* Regular Weather Bureau and selected cooperative stations.

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	12	2.89	81	—0.7	—3.0
Middle Atlantic	16	4.30	98	—0.1	—0.9
South Atlantic	10	6.63	110	+0.6	—1.4
Florida Peninsula*	8	5.80	88	—0.8	—4.7
East Gulf	11	5.91	111	+0.6	+0.5
West Gulf	10	2.77	85	—0.5	+1.2
Ohio Valley and Tennessee	13	3.53	88	—0.5	—0.8
Lower Lake	10	3.44	100	0.0	+1.1
Upper Lake	12	2.73	87	—0.4	+0.4
North Dakota*	9	2.46	92	—0.2	+0.6
Upper Mississippi Valley	15	2.83	78	—0.8	+2.3
Missouri Valley	12	3.40	89	—0.4	+2.9
Northern Slope	9	1.60	106	+0.1	+2.3
Middle Slope	6	2.61	87	—0.4	+3.3
Southern Slope*	7	3.15	111	+0.3	+5.1
Southern Plateau*	12	1.81	138	+0.5	+0.5
Middle Plateau*	10	1.04	162	+0.4	—0.3
Northern Plateau*	12	0.82	158	+0.3	—1.1
North Pacific	7	0.37	55	—0.3	—2.9
Middle Pacific	8	0.00	00	0.0	—3.9
South Pacific	4	0.00	00	0.0	—1.3

* Regular Weather Bureau and selected cooperative stations.

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	4.8	— 0.1	Missouri Valley	4.2	+ 0.1
Middle Atlantic	5.3	+ 0.5	Northern Slope	3.1	— 0.7
South Atlantic	5.4	+ 0.4	Middle Slope	4.8	+ 0.8
Florida Peninsula	4.7	— 0.3	Southern Slope	5.2	+ 1.4
East Gulf	6.2	+ 1.2	Southern Plateau	4.4	+ 1.1
West Gulf	4.4	+ 0.2	Middle Plateau	3.7	+ 1.7
Ohio Valley and Tennessee	5.0	+ 0.4	Northern Plateau	2.8	— 1.7
Lower Lake	4.0	— 0.5	North Pacific	4.2	— 0.2
Upper Lake	4.7	0.0	Middle Pacific	3.5	+ 0.6
North Dakota	3.5	— 0.4	South Pacific	2.3	— 0.4
Upper Mississippi Valley	4.7	+ 0.6			

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	79	— 1	Missouri Valley	69	+ 3
Middle Atlantic	75	+ 1	Northern Slope	58	+ 6
South Atlantic	81	+ 1	Middle Slope	66	+ 6
Florida Peninsula	79	— 1	Southern Slope	70	+11
East Gulf	80	+ 2	Southern Plateau	48	+ 8
West Gulf	75	+ 1	Middle Plateau	40	+ 7
Ohio Valley and Tennessee	71	+ 2	Northern Plateau	44	+ 3
Lower Lake	70	+ 1	North Pacific	73	0
Upper Lake	73	+ 1	Middle Pacific	60	0
North Dakota	62	— 4	South Pacific	61	— 3
Upper Mississippi Valley	72	+ 4			

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Atlanta, Ga	18	52	nw.	Lincoln, Nebr	5	52	sw.
Buffalo, N. Y	17	52	sw.	Minneapolis, Minn	17	53	nw.
Columbus, Ohio	26	53	e.	Mount Tamalpais, Cal.	31	52	nw.
El Paso, Tex	3	68	nw.	Pierre, S. Dak	3	55	nw.
Hatteras, N. C	31	58	nw.	Pittsburg, Pa	12	52	nw.
Havre, Mont	25	52	sw.	Point Reyes Light, Cal.	1	61	nw.
Jacksonville, Fla	18	54	sw.				

CLIMATOLOGICAL SUMMARY.

By Mr. P. C. DAY, Acting Chief, Climatological Division.

TEMPERATURE AND PRECIPITATION BY SECTIONS, JULY, 1908.

In the following table are given, for the various sections of the Climatological Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Section.	Temperature—in degrees Fahrenheit.								Precipitation—in inches and hundredths.					
			Monthly extremes.								Greatest monthly.		Least monthly.	
	Section average.	Departure from the normal.	Station.	Highest.	Date.	Station.	Lowest.	Date.	Section average.	Departure from the normal.	Station.	Amount.	Station.	Amount.
Alabama	79.8	— 0.2	Selma	103	17	Riverton	56	9	4.72	— 0.18	Highland Home	8.73	Talladega	1.70
Arizona	81.7	— 1.3	Fort Mohave	118	20	Valley Head	56	22	3.02	+ 1.47	Prescott	8.80	Parker	T.
Arkansas	79.2	— 0.9	Batesville No. 1	103	16, 17	Williams	37	5	3.00	— 0.97	Fort Smith	5.95	Camden	0.97
			Russellville	103	17	Pond	48	4						
California	76.4	+ 2.1	Orland	119	30	Tamarack	34	2	0.04	— 0.02	Idyllwild	1.50	Many stations	0.00
			Shasta	119	31	Truckee	34	14						
Colorado	65.6	— 1.2	Las Animas	106	5	Wagon Wheel Gap	20	4	2.60	+ 0.64	Stonewall	6.26	Glenwood Springs	T.
Florida	81.1	— 0.3	Grasmere	103	15, 17	Fenholloway	60	2	6.78	— 0.46	Fernandina	16.79	Sand Key	0.84
Georgia	79.8	— 0.3	Brunswick	102	16	Clayton	59	11	5.27	+ 0.11	St. Marys	13.28	Augusta	1.19
			Helena	102	18	Diamond	59	11						
Hawaii	72.9	.....	Kihei, Maui	92	19	Humuula, Hawaii	35	30	4.09	.....	Honokane, Hawaii	24.16	7 stations	0.00
Idaho	68.9	+ 1.9	Orofino	110	31	Forney	27	6	0.51	— 0.24	Hotspring	1.76	American Falls	0.00
Illinois	75.4	— 0.2	4 stations	100	4 d't's	Lanark	45	1,8	3.41	— 0.46	Chester	7.45	Martinton	1.24
Indiana	75.5	— 0.1	Zelma	103	31	Kokomo	41	8	2.94	— 0.18	Connersville	6.30	Paoli	0.69
Iowa	73.0	— 0.4	Rockwell City	100	11	4 stations	42	7,8	3.66	— 0.78	Alta (near)	9.21	Oskaloosa	0.70
			Odebolt	100	29									
Kansas	75.8	— 2.0	Ashland	107	10	Russell	41	7	3.47	— 0.69	Jewell	9.69	Sedan	1.08
Kentucky	76.9	— 0.4	Beattyville	100	13	Shelby City	50	9,13	3.94	— 0.19	Alpha	8.92	Scott	1.59
Louisiana	80.8	— 0.8	Melville	102	14	Minden	59	1	10.61	+ 5.19	Franklin	29.28	Grand Cane	2.16
			Monroe	102	16	Robeline	59	1						
Maryland and Delaware	76.6	+ 1.2	College Park, Md	102	12	Deer Park, Md	38	18	4.80	+ 0.05	Annapolis, Md	9.53	College Park, Md	1.42
Michigan	69.4	+ 1.0	3 stations	100	3 d't's	Roscommon	34	16	2.74	— 0.63	Mackinac Island	7.10	Port Austin	0.60
Minnesota	69.4	+ 0.3	St. Peter	101	10	Bagley	33	7	3.35	— 0.61	Winnebago	6.86	Crookston	0.83
Mississippi	80.2	— 0.6	Duck Hill	103	15	Austin	60	1	5.42	+ 0.62	Biloxi	19.16	Booneville	1.84
						Duck Hill	60	11						
Missouri	76.5	— 0.5	Princeton	101	13	Louisiana	48	20	3.23	— 1.18	Warrensburg	5.60	Mexico	1.10
Montana	67.5	+ 2.2	Chinook	106	31	Bowen	25	6	0.98	— 0.50	Columbia Falls	3.29	3 stations	0.00
Nebraska	72.4	— 1.5	Leavitt	104	29	Fort Robinson	35	2	4.28	+ 0.64	Geneva	10.20	Nemaha	0.95
						Winnebago	35	31						
Nevada	74.7	+ 4.1	Jean	116	16	3 stations	32	1, 16	0.42	+ 0.07	Panaca	1.78	Soda Lake	0.00
New England*	71.6	+ 2.4	Chestnut Hill, Mass.	101	12	Greenville, Me	34	17	3.61	— 0.28	Norwalk, Conn	6.90	Nantucket, Mass	1.00
New Jersey	75.6	+ 1.5	Browns Mills	106	12	Browns Mills	42	9	4.70	— 0.25	Clayton	8.12	Layton	1.97
						Layton	42	9,17						
New Mexico	70.8	— 1.6	Deming	104	4	Luna	33	1	2.79	+ 0.33	Winsors Ranch	8.23	Bloomfield	0.47
New York	71.1	+ 1.7	Ticonderoga	101	12	Paul Smiths	35	9	3.77	— 0.55	Addison	6.94	Scarsdale	1.21
North Carolina	77.2	— 0.1	Weldon	100	6	Banners Elk	45	10	8.13	+ 1.79	Newbern	17.60	Saxon	2.73
			Kinston	100	18									
North Dakota	68.6	+ 1.3	Napoleon	103	9	Langdon	31	7	2.10	— 0.38	Jamestown	5.00	Lakota	0.33
Ohio	73.9	+ 0.3	Philo	102	12	Garrettsville	42	9	4.08	— 0.02	Circleville	8.07	Cincinnati	0.83
						Rome	42	9						
Oklahoma	77.7	— 2.5	Hooker	108	10	Arapaho	49	3	3.15	— 1.14	Cache	10.84	Beaver	T.
Oregon	69.2	+ 3.3	Blalock	110	20	Granite	27	26	0.39	+ 0.16	Heppner	2.30	7 stations	0.00
			Payville	110	31									
Pennsylvania	73.9	+ 1.7	Marion	104	12	Pocono Lake	39	17	4.81	+ 0.36	Hanover	9.57	Renovo	2.15
Porto Rico	78.8	.....	Yauco	96	10, 19	5 stations	60	5 d't's	5.78	.....	Maricao	14.21	Guanica Centrale	2.03
South Carolina	79.8	— 0.3	Blackville	100	31	Liberty	60	10	5.43	— 0.32	Conway	11.15	Aiken	1.83
						Spartanburg	60	10						
South Dakota	71.6	+ 0.1	Alexandria	107	10	3 stations	38	2,7	3.19	+ 0.38	Montrose	7.98	Kennebec	0.47
Tennessee	77.5	+ 0.2	Covington	99	17	Erasmus	50	9	3.83	— 0.78	Harriman	11.64	Brownsville	0.85
Texas	80.9	— 1.5	Fort McIntosh	113	1	Texline	50	6,30	2.90	+ 0.11	Beaumont	13.41	Llano	0.02
Utah	71.5	— 0.3	Green River	108	5, 7	Park City	30	6	0.96	+ 0.41	Modena	2.76	2 stations	T.
Virginia	75.8	+ 0.1	Lincoln	102	14	Burkes Garden	43	16	5.11	+ 0.41	Warsaw	9.31	Clarksville	2.65
Washington	68.7	+ 1.6	Zindel	111	30, 31	Clealum	30	26	0.80	+ 0.04	Waterville	3.28	Goldendale	0.02
West Virginia	74.0	+ 0.4	Martinsburg	100	12	Bayard	41	16	5.21	+ 0.35	Valley Fork	9.43	Elkhorn	2.08
Wisconsin	70.4	+ 0.4	Sauk City	102	11	3 stations	35	8, 15	3.39	— 0.60	Appleton Marsh	6.57	Menasha	0.58
Wyoming	64.3	— 0.1	Basin	105	25	Kirwin	25	6	1.30	+ 0.11	Pine Bluff	4.91	Basin	0.00

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

DESCRIPTION OF TABLES AND CHARTS.

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For description of tables and charts see page 8 of REVIEW for January, 1908.

TABLE I.—*Climatological data for U. S. Weather Bureau stations, July, 1908.*

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.								Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.				Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.				
New England.							71.0	+ 2.1									79	2.89	— 0.7									4.8	
Eastport	76	69	85	29.92	30.00	+ .07	62.4	+ 2.6	86	12	71	49	17	54	30	57	54	79	1.95	— 1.5	9	6,019	s.	39	se.	18	6	17	8	5.7
Greenville	.....	.....	.....	28.87	30.02	.....	66.5	.....	90	7	79	34	17	54	40	.....	.....	.....	5.18	.....	12	.....	se.	.....	.....	.....	.....	.....	.....	.....
Portland, Me.	108	81	117	29.91	30.03	+ .08	69.8	+ 3.0	98	12	79	53	17	61	34	63	60	75	2.58	— 0.7	14	6,106	s.	36	s.	18	11	16	4	5.0
Concord	288	70	79	29.72	30.03	+ .07	71.6	+ 2.5	95	12	83	43	17	60	34	.....	.....	.....	2.07	— 1.7	9	3,464	se.	23	nw.	16	23	6	2	2.3
Burlington	404	12	47	29.60	30.02	+ .08	71.6	+ 0.4	96	7	82	47	17	61	32	.....	.....	.....	2.66	— 1.1	10	6,780	s.	39	s.	7	15	10	6	4.7
Northfield	876	16	70	29.11	30.03	+ .09	68.2	+ 1.6	92	12	81	40	17	55	37	66	64	85	2.05	— 1.6	12	5,161	s.	34	sw.	7	5	21	5	5.7
Boston	125	115	188	29.91	30.04	+ .08	74.1	+ 2.8	97	12	83	58	16	65	27	66	63	71	3.17	— 0.2	7	6,987	sw.	28	w.	8	6	14	11	6.1
Nantucket	12	14	90	30.04	30.05	+ .07	71.0	+ 3.5	89	7	78	56	29	64	20	67	66	88	1.00	— 1.7	8	10,161	sw.	39	sw.	18	12	16	3	4.8
Block Island	26	11	46	30.03	30.06	+ .09	70.4	+ 2.3	87	7	77	58	9	64	18	67	65	87	2.34	— 1.0	5	9,769	sw.	38	nw.	14	12	16	3	4.5
Narragansett	.....	9	.....	.....	.....	.....	70.6	+ 0.7	90	13	78	50	17	63	24	...	...	...	2.78	... ...	9	.....	sw.	...	.....	...	22	5	4	.....
Providence	160	57	67	29.89	30.06	+ .09	73.0	— 0.4	95	12	83	55	17	63	29	66	63	75	4.33	+ 1.0	11	4,267	sw.	20	w.	8	13	14	4	4.4
Hartford	159	122	132	29.88	30.05	+ .08	74.6	+ 3.0	96	12	84	54	17	65	30	68	66	81	5.74	+ 1.6	11	4,930	s.	36	nw.	18	6	16	9	5.8
New Haven	106	116	155	29.94	30.05	+ .08	74.6	+ 2.7	94	6	83	56	9	66	26	67	64	74	3.94	— 0.8	8	5,668	s.	26	nw.	14	13	14	4	4.2
Mid. Atlantic States.							75.8	+ 1.2									75	4.30	— 0.1									5.3	
Albany	97	102	115	29.93	30.03	+ .07	74.6	+ 2.6	93	7	85	53	9	64	31	67	63	72	5.33	+ 1.4	13	4,651	s.	38	s.	18	10	18	3	4.6
Binghamton	871	78	90	29.15	30.06	+ .09	71.6	+ 1.7	93	31	83	45	9	60	34	.....	.....	.....	3.58	0.0	13	3,550	ne.	26	sw.	17	11	6	14	5.6
New York	314	108	350	29.72	30.05	+ .07	76.8	+ 3.3	93	12	84	62	16	69	23	68	64	72	4.33	— 0.2	8	6,528	s.	33	w.	8	9	16	6	5.3
Harrisburg	374	94	104	29.66	30.06	+ .08	76.4	+ 1.9	97	12	86	59	9	67	30	68	65	73	5.51	+ 1.6	14	4,124	s.	33	nw.	12	9	17	5	5.2
Philadelphia	117	116	184	29.95	30.07	+ .09	78.4	+ 2.6	97	12	86	65	11	71	26	69	65	70	4.54	+ 0.2	11	6,095	s.	36	nw.	12	6	15	10	5.8
Scranton	805	111	119	29.21	30.06	+ .08	74.4	+ 2.6	95	12	85	49	9	63	34	65	61	68	2.92	— 0.9	10	3,968	sw.	25	w.	7	10	13	8	5.1
Atlantic City	52	37	48	30.02	30.07	+ .09	73.6	+ 1.1	92	19	79	61	9	68	24	69	67	82	4.16	+ 0.4	9	5,193	sw.	26	s.	17	5	15	11	6.4
Cape May	17	48	52	30.07	30.09	+ .11	73.0	— 0.4	89	19	78	60	9	68	20	70	...	...	3.12	— 0.7	14	5,003	s.	22	w.	14	9	17	5	4.9
Baltimore	123	100	113	29.92	30.05	+ .07	79.0	+ 1.7	97	12	87	64	17	71	29	70	66	70	4.34	— 0.5	14	4,988	sw.	40	sw.	12	6	12	13	6.3
Washington	112	59	76	29.94	30.06	+ .06	78.0	+ 1.2	99	12	87	57	17	69	31	70	66	73	3.29	— 1.4	14	4,539	sw.	30	se.	23	6	17	8	5.8
Cape Henry	18	9	58	30.03	30.05	+ .06	78.6	+ 1.1	95	14	85	61	17	72	25	...	...	...	3.52	— 2.3	12	9,625	sw.	44	ne.	31	16	7	8	4.6
Lynchburg	681	83	88	29.35	30.00	+ .08	77.0	— 0.3	95	12	87	56	17	67	32	70	67	76	4.49	+ 0.5	12	2 830	sw.	17	ne.	30	10	15	6	5.2
Mount Weather	1,725	10	54	28.29	30.06	+ .07	72.0	+ 0.6	89	12	80	54	16	64	22	65	63	79	3.15	— 1.5	14	7,256	se.	37	nw.	7	6	13	12	6.0
Norfolk	91	102	111	29.97	30.06	+ .06	79.2	+ 0.8	93	13	86	65	10	72	21	73	71	79	5.78	0.0	14	6,752	s.	26	n.	31	9	13	9	5.5
Richmond	144	145	153	29.93	30.08	+ .07	78.9	— 0.3	96	12	88	62	17	70	27	...	...	...	4.37	0.0	16	5,847	ne.	37	s.	25	13	10	8	4.7
Wytheville	2,293	40	47	27.77	30.08	+ .07	71.6	— 1.0	87	13	81	52	17	62	30	67	66	89	6.30	+ 1.9	17	2,37.	e.	24	nw.	14	10	16	5	4.5
S. Atlantic States.							79.1	+ 0.3									81	6.61	+ 0.6									5.4	
Asheville	2,255	53	75	27.79	30.08	+ .06	72.4	+ 0.7	90	18	82	57	10	63	30	66	65	85	7.56	+ 2.7	18	3,551	se.	30	se.	9	4	16	11	6.3
Charlotte	773	68	76	29.26	30.08	+ .06	77.9	— 0.8	94	21	86	62	10	69	24	71	68	78	5.62	+ 0.1	14	4,237	ne.	26	sw.	4	8	13	10	5.7
Hatteras	11	12	47	30.04	30.06	+ .05	80.0	+ 1.4	89	15	85	69	9	75	15	76	75	86	7.55	+ 1.4	10	9,810	sw.	58	nw.	31	22	4	5	3.5
Manteo	.....	.....	.....	.....	.....	.....	78.6	.....	95	13	85	65	11	73	.....	.....	.....	.....	11.52	+ 5.4	11	.....	s.	.....	.....	.....	17	9	5	.....
Raleigh	376	71	79	29.67	30.06	+ .04	78.6	+ 0.1	96	13	88	63	11	70	26	71	69	78	6.14	0.0	18	4,597	sw.	30	s.	2	7	16	8	5.8
Wilmington	78	81	91	29.96	30.04	+ .03	79.0	+ 0.3	93	15	86	66	10	72	21	74	72	82	9.40	+ 2.4	11	6,102	sw.	48	ne.	30	6	18	7	5.5
Charleston	48	14	92	30.00	30.05	+ .02	81.4	+ 0.1	95	15	87	68	10	76	22	75	73	78	2.80	— 4.5	13	8,682	s.	37	e.	26	5	19	7	5.2
Columbia, S. C.	351	41	57	29.68	30.06	+ .04	80.0	+ 1.1	97	18	89	64	10	71	25	72	69	76	3.46	— 2.6	10	4,585	s.	30	ne.	13	7	15	9	6.1
Augusta	180	89	97	29.86	30.05	+ .03	81.0	+ 0.5	96	15	90	65	10	72	24	73	71	79	1.19	— 4.1	9	4,581	se.	38	nw.	18	16	15	0	3.5
Savannah	65	81	89	29.98	30.05	+ .02	80.2	— 0.3	97	21	87	69	28	73	21	74	72	81	8.03	+ 1.8	18	5,118	w.	28	w.	18	7	13	11	6.0
Jacksonville	43	101	129	30.00	30.05	+ .02	80.2	— 0.7	94	16	87	70	14	73	20	75	74	86	9.68	+ 3.5	19	6,150	sw.	54	sw.	18	4	17	10	6.1
Florida Peninsula.							81.9	+ 0.3									79	2.28	— 3.0									4.7	
Jupiter	28	10	48	30.01	30.04	+ .01	81.0	0.0	95	18	88	70	25	74	20	74	74	85	4.27	— 1.1	17	6,518	w.	38	se.	5	5	22	4	5.1
Key West	22	10	53	30.02	30.04	+ .01	83.0	— 0.7	91	15	88	71	20	78	19	76	73	74	1.25	— 2.3	11	6,238	e.	38	nw.	28	10	16	5	4.6
Sand Key	25	41	71	30.00	30.03	.00	82.0	.....	91	20	85	67	20	79	24	...	...	...	0.84	— 2.7	8	8,108	e.	46	ne.	20	12	14	5	4.4
Tampa	35	79	96	30.02	30.05	+ .01	81.6	+ 1.6	93	22	90	67	5	74	22	75	73	79	2.75	— 5.7	14	4,979	w.	34	sw.	10	9	18	4	4.7
East Gulf States.							80.1	— 0.2									80	5.91	+ 0.6									6.2	
Atlanta	1,174	190	216	28.86	30.07	+ .05	77.8	+ 0.2	93	18	87	64	10	69	26	71	69	80	5.09	+ 0.4	14	6,935	e.	52	nw.	18	9	13	9	5.5
Macon	370	55	66	29.67	30.06	+ .04	81.2	+ 1.5	97	15	91	67	10	72	26	.....	.....	.....	4.68	0.0	13	3,157	ne.	30	sw.	4	8	13	10	6.3
Thomasville	278	8	58	29.76	30.05	+ .02	80.6	— 1.2	95	16	91	67	7	70	27	74	73	87	7.40	+ 2.1	18	3,336	sw.	28	sw.	14	6	18	7	5.5
Pensacola	56	79	96	29.99	30.05	+ .04	80.8	— 0.6	93	16	87	71	24	75	20	..	...	...	6.82	— 0.4	21	6,051	s.	30	sw.	9	3	14	14	6.8
Anniston	741	9	58	29.31	30.09	+ .07	78.8	+ 0.9	95	17	89	63	22	69	31	...	...	...	5.03	+ 0.3	12	3,442	e.	28	ne.	1	4	10	17	6.9
Birmingham	700	11	48	29.32	30.07	+ .06	79.8	— 1.7	93	18	90	67	10	70	27	71	69	78	2.51	— 1.2	16	3,873	se.	31	nw.	18	2	15	14	6.8
Mobile	57	98	106	29.98	30.04	+ .03	81.0	+ 0.5	97	16	88	70	30	74	22	74	72	79	7.41	+ 0.4	15	4,512	nw.	32	nw.	21	5	19	7	6.0
Montgomery	223	100	112	29.81	30.06	+ .04	80.8	— 0.2	97	17	90	68	20	71	25	72	69	75	4.75	+ 0.1	10	4,031	nw.	32	nw.	19	3	15	13	6.6
Meridian	378	84	93	29.66	30.04	+ .02	79.3	— 0.7	95	17	89	66	23	70	26	72	70	81	6.07	+ 1.6	17	3,095	e.	28	e.	23	9	10	12	5.9
Vicksburg	247	62	74	29.77	30.04	+ .04	80.1	— 0.3	95	16	88	68	1	72	21	73	71	79	3.23	— 1.2	13	4,133	e.	28	sw.	19	9	13	9	5.4
New Orleans	51	88	121	29.97	30.02	+ .02	81.2	— 0.1	94	16	88	70	30	74	20	74	73	82	11.03	+ 4.6	20	5,085	se.	38	se.	23	1	22	8	6.2
West Gulf States.							80.8	— 1.0									75	2.77	— 0.5									4.4	
Shreveport	249	77	84	29.76	30.02	+ .04	81.6	— 0.5	97	17	91	68	22	73	24	73	70	77	3.93	+ 0.2	12	4,037	se.	29	se.	19	9	14	8	5.2
Bentonville	1,303	11	44	28.70	30.04	+ .07	75.6	— 2.9	94	17	87	53	4	64	33	...	...	...	3.03	— 1.3	5	2,859	s.	18	nw.	18	18	12	1	3.4
Fort Smith	457	79	94	29.54	30.01	+ .04	79.5	— 1.5	97	17	90	60	4	69	30	71	68	72	5.95	+ 2.1	8	4,261	e.	39	w.	25	22	6	3	3.0
Little Rock	357	139	147	29.67	30.04	+ .05	80.0	— 0.6	96	16	89	64	1	71	22	72	69	72	1.08	— 2.9	9	5,160	e.	30	ne.	31	14	16	1	3.8
Corpus Christi	20	48	53	29.98	30.00	+ .04	82.8	+ 0.1	94	29	89	68	28	76	24	76	74	78	1.62	0.0	8	6,835	se.	31	s.	19	13	14	4	4.0
Fort Worth	670	106	114	29.32	30.02	+ .06	81.2	— 2.5	98	17	90	64	4	72	26	...	...	...	2.66	— 0.4	8	5,415	ne.	32	s.	13	11	19	1	4.4
Galveston	54	106	112	29.97	30.03	+ .05	81.9	— 1.1	91	26	87	67	3	77	16	76	74	79	7.28	+ 3.3	16	6,033	se.	34	n.	11	7	22	2	5.0
Palestine	510	73	79	29.48	30.00	+ .03	80.4	— 1.1	94	11	90	66	1	71	24	72	70	79	1.17	— 1.8	9	2,440	ne.	9	nw.	7	4	6	21	6.9
San Antonio	701	80	91	29.27	29.98	+ .03	82.6	+ 0.2	100	26	94	68	13	72	28	72	68	71	0.66	— 1.6	9	4,113	se.	27	n.	2	10	19	2	4.7
Taylor	583	55	63	29.41	30.02	+ .06	82.2	— 0.5	98	22	93	68	1	72	26	.....	...	...	0.35	— 2.3	3	5,000	s.	27	s.	19	17	11	3	3.6
Ohio Val. and Tenn.							77.1	+ 0.3									71	3.53	— 0.6									5.0	
Chattanooga	762	106	112	29.29	30.08	+ .06	78.7	+ 0.9	94	18	88	63	17	69	29	69	66	72	2.43	— 1.4	11	4,012	ne.	39	nw.	18	6	18	7	5.7
Knoxville	1,004	93	100	29.04	30.07	+ .05	77.2	+ 1.0	92	12	86	62	17	68	27	69	67	77	3.90	— 0.3	14	2,949	ne.	27	sw.	24	5	11	15	6.6
Memphis	399	76	97	29.64	30.06	+ .06	80.5	+ 0.2	94	17	88	67	1	73	22	73	70	74	3.50	0.0	10	4,830	e.	30	sw.	19	11	8	12	5.5
Nashville	546	79	91	29.50	30.07	+ .06	78.4	— 1.0	94	17	88	61	9	69	27	71	68	76	3.32	— 1.0	11	3,472	w.	24	sw.	20	11	11	9	5.2
Lexington	989	75	102	29.03	30.07	+ .06	76.0	— 0.6	92	12	86	56	8	66	28	.....	...	...	3.60	— 0.8	12	3,790	ne.	36	nw.	17	16	6	9	4.2
Louisville	525	111	132	29.50	30.07	+ .07	79.4	+ 0.8	97	12	90	60	8	69	29	68	63	64	3.61	— 0.1	12	4,852	sw.	36	w.	17	16	7	8	4.0
Evansville	431	72	82	29.58	30.04	+ .04	78.9	— 0.4	95	17	88	60	8	69	26	.....	...	...	1.97	— 1.8	10	4,118	s.	30	w.	17	8	21	2	4.7
Indianapolis	822	154	164	29.18	30.05	+ .06	76.0	— 0.2	95	12	86	57	8	66	27	67	62	64	2.62	— 1.5	12	5,844	sw.	35	sw.	17	11	9	11	5.3
Cincinnati	628	152	160	29.39	30.06	+ .06	78.0	+ 0.3	96	12	88	58	8	68	31	67	62	62	0.83	— 2.7	9	4,097	e.	28	nw.	14	15	8	8	4.6
Columbus	824	173	224	29.20	30.06	+ .06	75.6	+ 0.3	96	12	86	54	8	65	28	67	62	69	3.74	+ 0.1	13	6,573	sw.	53	e.	26	12	9	10	4.8
Pittsburg	842	336	352	29.17	30.05	+ .05	74.9	+ 0.3	92	6	85	54	16	65	27	66	62	68	5.07	+ 0.6	12	5,408	sw.	52	nw.	12	9	14	8	5.3
Parkersburg	638	77	84	29.42	30.08	+ .07	76.6	+ 1.0	95	12	87	53	16	66	30	68	65	76	3.32	— 1.3	13	3,365	s.	33	nw.	17	16	11	4	4.3
Elkins	1,940	41	50	28.09	30.08	+ .07	71.6	+ 1.1	88	21	84	49	16	60	36	65	63	83	7.88	+ 3.2	16	1,994	s.	24	w.	17	13	10	8	4.7
Lower Lake Region.							71.8	+ 0.3									70	3.44	0.0									4.0	
Buffalo	767	178	206	29.23	30.04	+ .07	71.0	+ 0.8	88	29	78	55	16	64	21	66	63	75	3.40	0.0	11	8,293	sw.	52	sw.	17	16	10	5	4.1
Canton	448	10	71	29.56	30.03	.....	70.4	— 0.1	92	7	80	48	16	60	28	...	...	...	4.95	+ 1.7	13	7,439	sw.	45	sw.	7	16	9	6	4.0
Oswego	335	76	91	29.66	30.03	+ .07	70.2	+ 0.6	90	11	78	54	9	63	26	65	62	74	4.77	+ 1.5	10	5,324	s.	28	w.	8	15	10	6	4.0
Rochester	523	81	102	29.49	30.03	+ .08	71.9	+ 1.5	92	6	81	55	15	63	28	64	60	68	4.56	+ 1.5	10	5,001	sw.	29	sw.	17	15	8	8	4.3
Syracuse	597	97	113	29.42	30.06	+ .09	71.6	+ 0.8	90	7	80	55	8	63	28	...	...	...	3.68	0.0	10	6,441	s.	46	s.	7	15	12	4	4.3
Erie	713	92	102	29.29	30.04	+ .06	71.6	— 0.2	87	13	78	55	9	65	21	65	61	68	2.26	— 1.0	10	6,292	s.	31	s.	17	17	10	4	3.5
Cleveland	762	190	201	29.25	30.06	+ .07	71.6	— 0.9	91	11	79	54	9	65	27	65	62	70	2.15	— 1.4	10	8,530	se.	44	w.	18	15	10	6	3.6
Sandusky	629	62	70	29.38	30.05	+ .06	73.4	— 0.2	93	11	81	56	9	66	27	...	...	...	3.34	— 0.4	10	5,183	ne.	30	nw.	7	13	12	6	3.9
Toledo	628	207	246	29.38	30.08	+ .09	73.8	+ 0.1	97	12	83	54	8	65	24	66	62	69	3.43	+ 0.2	11	8,379	sw.	48	sw.	17	18	9	4	3.6
Detroit	730	218	258	29.28	30.06	+ .08	72.8	+ 0.8	94	12	82	50	8	64	24	65	60	67	1.83	— 1.6	10	8,387	e.	46	w.	17	14	14	3	4.2
Upper Lake Region.							68.4	+ 0.6									73	2.73	— 0.4									4.7	
Alpena	609	13	92	29.39	30.05	+ .08	67.0	+ 1.2	94	30	77	46	8	57	31	61	58	77	2.95	— 0.1	9	6,063	se.	32	nw.	7	14	8	9	4.5

TABLE I.—*Climatological data for U. S. Weather Bureau stations, July, 1908*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.										Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with .01, or more.	Total movement miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
Up. Lake Reg—Cont.																														
Escanaba	612	40	82	29.39	30.05	+ .08	65.8	— 0.7	89	30	74	47	8	57	25	62	59	77	3.80	+ 0.5	9	6,202	s.	30	sw.	10	12	10	9	4.7	
Grand Haven	632	54	92	29.36	30.03	+ .05	69.8	+ 0.1	90	26	79	52	7	61	27	64	60	72	2.00	— 0.6	10	6,579	s.	28	nw.	7	13	16	2	4.4	
Grand Rapids	707	121	162	29.30	30.05	+ .07	73.0	+ 0.4	95	29	84	51	8	62	28	64	59	65	1.46	— 1.2	8	6,670	e.	31	w.	17	11	14	6	5.2	
Houghton	668	66	74	29.31	30.03	+ .07	66.0	+ 0.7	92	29	76	46	19	56	28	.....	.....	.....	3.30	+ 0.2	12	4,303	w.	26	n.	27	14	9	8	4.5	
Marquette	734	77	116	29.25	30.05	+ .09	66.0	+ 1.1	93	29	74	48	7	58	28	59	54	69	2.93	— 0.2	11	6,396	nw.	36	sw.	10	11	14	6	4.8	
Port Huron	638	70	120	29.37	30.05	+ .07	70.4	+ 1.4	94	11	80	50	8	61	29	64	60	71	1.09	— 1.6	10	6,624	ne.	48	nw.	13	14	12	5	4.1	
Sault Sainte Marie	614	40	61	29.37	30.05	+ .08	64.0	+ 2.1	92	29	74	45	20	54	31	59	56	78	3.46	+ 0.7	13	4,748	w.	36	nw.	7	11	11	9	5.3	
Chicago	823	140	310	29.18	30.05	+ .07	74.3	+ 1.9	96	11	80	60	8	68	23	67	65	75	1.45	— 2.2	9	8,552	sw.	41	sw.	6	9	18	4	4.8	
Milwaukee	681	122	139	29.34	30.07	+ .10	70.8	+ 1.1	94	11	78	54	7	64	30	65	62	75	2.56	— 0.4	8	6,171	ne.	30	sw.	10	15	12	4	4.0	
Green Bay	617	49	86	29.36	30.02	+ .05	70.3	+ 0.8	95	11	80	48	1	60	26	63	59	71	2.44	— 1.1	11	6,089	sw.	48	w.	6	9	16	6	5.8	
Duluth	1,133	11	47	28.83	30.04	+ .09	63.6	— 2.4	92	10	73	44	3	55	29	59	57	80	5.34	+ 1.7	11	7,955	ne.	47	w.	20	14	12	5	4.7	
North Dakota.							69.3	+ 0.2										62	1.94	— 1.0									3.5	
Moorhead	940	8	57	29.02	30.02	+ .08	69.4	+ 0.7	95	10	82	41	7	57	38	63	60	73	4.76	+ 1.0	11	4,850	s.	22	sw.	16	21	9	1	2.6	
Bismarck	1,674	8	57	28.26	30.01	+ .08	71.3	+ 1.1	100	9	86	43	6	56	43	61	54	59	0.82	— 1.3	8	6,938	nw.	47	w.	24	17	11	3	3.6	
Devils Lake	1,482	11	44	28.42	29.97	+ .04	67.4	— 0.7	97	9	80	39	6	54	35	59	53	62	1.56	— 2.2	11	7,157	nw.	32	nw.	29	12	9	10	5.0	
Williston	1,875	14	56	28.01	29.94	+ .02	69.1	— 0.3	99	31	84	36	6	54	47	59	52	56	0.60	— 1.4	5	6,817	s.	36	sw.	24	23	6	2	2.8	
Upper Miss. Valley.							74.5	— 0.9										72	2.83	— 0.8									4.7	
Minneapolis	.....	102	208	.....	.....	.....	72.6	.....	94	10	82	50	7	63	25	.....	.....	.....	2.19	— 1.6	8	7,127	s.	53	nw.	17	16	10	5	4.0	
St. Paul	837	171	179	29.14	30.04	+ .09	72.2	+ 0.1	93	10	81	49	7	63	23	64	60	69	2.94	— 0.5	10	5,710	n.	43	nw.	17	17	12	2	3.5	
La Crosse	714	10	49	29.28	30.03	+ .07	72.2	— 0.4	95	10	82	52	1	62	29	.....	.....	.....	2.81	— 1.3	13	2,886	se.	19	nw.	6	10	10	11	5.5	
Madison	974	70	78	29.02	30.04	+ .07	70.8	— 1.6	93	11	80	52	1	62	25	64	61	73	2.85	— 1.1	10	5,259	s.	31	s.	5	15	12	4	4.2	
Charles City	1,015	3	49	28.99	30.04	+ .08	71.6	— 1.9	94	10	82	50	8	61	29	66	63	78	4.34	+ 0.8	12	3,777	se.	24	sw.	16	4	17	10	6.1	
Davenport	606	71	79	29.38	30.04	+ .07	75.1	— 0.3	94	30	85	57	8	66	26	67	64	72	3.30	+ 0.2	8	4,287	sw.	31	sw.	16	13	13	5	4.6	
Des Moines	861	84	101	29.13	30.02	+ .06	74.4	— 1.1	94	10	84	52	7	65	28	66	62	70	1.56	— 2.3	8	4,972	sw.	33	sw.	5	5	21	5	5.5	
Dubuque	698	100	117	29.31	30.05	+ .08	73.4	— 1.3	96	11	83	53	8	64	26	66	62	71	2.06	— 2.2	9	3,245	se.	24	n.	12	11	15	5	4.8	
Keokuk	614	64	77	29.38	30.05	+ .07	76.1	— 0.9	94	30	85	57	8	67	24	68	65	73	3.70	— 0.3	8	3,977	s.	36	sw.	16	16	13	2	3.8	
Cairo	356	87	93	29.68	30.05	+ .05	78.6	0.0	93	17	87	62	8	70	21	70	67	73	1.92	— 1.5	13	4,460	s.	30	n.	17	14	7	10	4.7	
La Salle	536	56	64	29.49	30.05	+ .08	74.2	— 1.1	96	11	85	52	8	64	29	.....	.....	.....	3.72	+ 0.4	11	4,385	sw.	27	sw.	16	10	12	9	5.1	
Peoria	609	11	45	29.40	30.06	+ .08	74.2	— 1.2	94	11	85	49	8	63	31	67	64	74	3.94	+ 1.0	13	4,231	sw.	40	sw.	16	14	14	3	4.0	
Springfield, Ill	644	10	92	29.36	30.04	+ .06	76.4	— 0.1	94	12	86	56	8	66	27	67	63	66	1.37	— 1.5	5	4,814	sw.	29	sw.	17	12	15	4	4.6	
Hannibal	534	75	109	29.47	30.04	+ .06	75.9	— 1.5	94	11	86	54	8	66	30	.....	.....	.....	1.48	— 2.3	11	4,861	sw.	30	sw.	24	12	12	7	4.7	
St. Louis	567	208	217	29.44	30.03	+ .04	77.7	— 1.4	92	31	85	61	8	70	20	69	66	71	4.24	+ 0.8	7	5,519	se.	26	sw.	6	14	8	9	5.0	
Missouri Valley.							74.2	— 1.5										69	3.40	— 0.4									4.2	
Columbia, Mo	784	11	84	29.23	30.04	+ .06	75.4	— 2.0	94	11	86	53	8	64	30	.....	.....	.....	2.97	— 0.7	8	4,029	s.	32	sw.	24	11	15	5	4.4	
Kansas City	963	116	181	29.02	30.02	+ .05	76.3	— 1.3	93	17	85	55	7	68	28	68	65	71	2.18	— 2.7	9	6,880	s.	37	n.	14	15	12	4	4.0	
Springfield, Mo	1,324	98	104	28.67	30.04	+ .06	75.2	— 1.2	93	17	85	58	4	65	28	67	63	69	2.56	— 2.2	7	5,483	se.	34	nw.	6	24	7	0	1.9	
Iola	984	11	50	29.02	30.04	+ .07	76.4	— 1.7	95	21	87	55	8	66	32	.....	.....	.....	2.18	— 1.7	8	3,947	sw.	23	n.	21	11	14	6	4.8	
Topeka	.....	85	89	.....	.....	.....	76.0	— 1.6	95	17	86	52	7	66	28	.....	.....	.....	3.91	— 0.9	7	5,572	se.	31	sw.	17	18	11	2	3.2	
Lincoln	1,189	11	84	28.78	30.02	+ .07	74.2	— 2.2	94	11	84	52	3	64	28	67	64	73	8.08	+ 4.2	11	6,266	s.	52	sw.	5	12	13	6	4.7	
Omaha	1,105	115	121	28.87	30.03	+ .08	74.4	— 2.1	94	28	83	52	7	66	26	66	62	68	2.47	— 1.9	6	5,185	s.	35	nw.	5	9	9	13	5.9	
Valentine	2,598	47	54	27.36	30.04	+ .11	71.5	— 1.7	101	10	84	49	2	59	39	62	56	66	2.33	— 1.1	8	7,218	s.	44	n.	25	10	20	1	4.0	
Sioux City	1,135	96	164	28.84	30.02	+ .07	72.8	— 1.4	95	10	83	49	7	63	29	.....	.....	.....	2.73	— 0.9	8	7,196	s.	35	nw.	17	14	7	10	5.0	
Pierre	1,572	70	75	28.37	30.01	+ .08	75.2	0.0	101	10	88	49	2	63	34	63	57	60	3.04	+ 0.7	8	6,605	se.	55	nw.	5	10	17	4	4.3	
Huron	1,306	56	67	28.66	30.03	+ .09	71.0	— 0.5	99	10	83	49	7	59	32	65	62	75	4.12	+ 1.2	9	6,734	se.	36	se.	25	19	8	4	3.3	
Yankton	1,233	49	57	28.72	30.01	+ .07	72.1	— 2.5	100	10	84	47	7	61	32	.....	.....	.....	4.27	+ 0.8	5	4,033	n.	24	nw.	25	7	17	7	5.4	
Northern Slope.							69.5	+ 0.4										58	1.68	+ 0.1									3.1	
Havre	2,505	11	44	27.36	29.94	+ .03	71.4	+ 3.3	103	31	88	42	1	55	50	59	52	56	0.39	— 1.5	5	5,974	nw.	52	sw.	25	24	7	0	2.7	
Miles City	2,371	26	48	27.51	30.00	+ .08	75.1	+ 2.2	102	31	91	47	1	59	50	61	53	55	1.97	+ 0.6	9	3,718	e.	42	w.	16	24	7	0	2.1	
Helena	4,110	8	56	25.89	30.00	+ .07	68.5	+ 1.9	98	31	83	38	6	54	42	54	45	50	1.40	+ 0.3	7	4,758	sw.	36	w.	16	20	8	3	2.8	
Kalispell	2,962	8	34	26.97	29.97	+ .04	66.2	+ 1.8	92	31	81	39	6	51	42	54	47	58	1.44	+ 0.6	6	3,838	nw.	23	se.	22	21	9	1	2.5	
Rapid City	3,234	46	50	26.69	30.03	+ .10	70.4	+ 0.2	96	28	82	47	3	58	35	60	53	57	1.26	— 1.3	7	5,144	w.	33	nw.	4	19	10	2	3.1	
Cheyenne	6,088	56	64	24.17	30.03	+ .11	65.0	— 2.4	89	10	78	36	2	52	36	54	48	63	4.33	+ 2.3	17	5,461	s.	34	nw.	22	9	20	2	4.7	
Lander	5,372	26	36	24.78	30.02	+ .10	66.6	— 1.4	92	25	83	37	2	51	43	54	46	56	0.40	— 0.5	8	2,306	sw.	24	sw.	23	12	18	1	3.8	
Sheridan	3,790	9	47	26.18	30.01	.....	68.2	.....	95	31	84	40	2	53	42	57	49	56	0.66	.....	4	4,553	se.	46	nw.	16	23	7	1	2.5	
Yellowstone Park	6,200	11	48	24.04	30.04	+ .12	61.8	+ 0.3	88	31	78	32	6	46	40	50	42	56	0.73	— 0.4	12	4,821	sw.	36	sw.	23	10	17	4	4.5	
North Platte	2,821	11	51	27.16	30.04	+ .11	71.9	— 2.0	95	10	84	49	3	60	34	64	60	72	3.17	+ 0.5	12	4,958	se.	37	sw.	12	21	7	3	2.6	
Middle Slope.							74.3	— 2.3										66	2.61	— 0.4									4.3	
Denver	5,291	129	136	24.86	30.03	+ .12	69.8	— 2.0	92	28	83	44	6	57	36	56	48	54	2.09	+ 0.5	10	5,318	sw.	46	ne.	18	11	19	1	4.4	
Leadville	10,248	7	....	.....	.....	.....	54.6	.....	75	27	69	33	2	40	.....	.....	.....	.....	1.43	.....	14	.....	n.	.....	.....	.....	.....	.....	.....	.....	
Pueblo	4,685	80	86	25.40	30.00	+ .09	73.1	— 0.1	99	5	86	52	3	60	39	57	49	52	0.92	— 1.0	7	5,544	se.	40	w.	21	12	16	3	4.3	
Concordia	1,398	42	50	28.59	30.03	+ .08	74.6	— 3.5	95	16	85	49	7	64	29	67	64	72	6.77	+ 3.2	10	4,516	se.	23	s.	5	10	18	3	5.2	
Dodge	2,509	44	54	27.46	30.01	+ .08	75.2	— 2.5	98	10	87	50	7	64	30	66	62	71	1.67	— 1.7	9	6,242	se.	29	se.	21	14	15	2	4.1	
Wichita	1,358	90	120	28.64	30.04	+ .08	76.6	— 2.4	94	21	86	55	7	67	28	68	64	70	2.96	— 0.7	9	6,444	s.	36	e.	21	7	19	5	5.2	
Oklahoma	1,214	10	47	28.76	30.01	+ .05	76.6	— 3.2	93	17	86	60	8	67	24	69	66	75	1.27	— 2.4	7	8,078	s.	38	nw.	6	8	17	6	5.5	
Southern Slope.							77.4	— 3.1										70	3.70	+ 0.9									5.2	
Abilene	1,738	45	54	28.23	30.01	+ .08	78.7	— 3.5	96	10	89	62	1	69	28	69	65	70	4.77	+ 2.4	12	4,842	se.	34	e.	13	3	19	9	6.4	
Amarillo	3,676	10	49	26.35	30.01	+ .09	72.8	— 3.3	96	11	84	55	7	62	31	64	60	71	5.40	+ 2.2	11	8,460	s.	36	s.	12	16	13	2	4.2	
Del Rio	944	8	57	28.99	29.96	+ .06	82.8	— 1.9	100	26	94	68	26	72	32	.....	.....	.....	2.45	+ 0.2	11	6,234	se.	36	ne.	2	10	14	7	4.9	
Roswell	3,578	9	57	26.43	30.00	+ .12	75.1	— 3.8	96	5	87	57	3	63	34	64	60	69	2.16	— 1.3	12	3,696	se.	42	n.	2	6	21	4	5.5	
Southern Plateau.							78.1	— 0.9										48	2.12	+ 0.8									4.4	
El Paso	3,762	110	133	26.22	29.89	+ .05	78.3	— 2.2	100	5	89	60	2	67	35	63	54	52	2.07	— 0.1	7	8,114	e.	68	nw.	3	5	21	5	5.1	
Santa Fe	7,013	33	39	23.39	29.92	+ .04	65.9	— 2.8	85	5	78	47	3	54	32	54	48	59	2.14	— 0.6	17	5,590	se.	37	e.	6	4	24	3	5.3	
Flagstaff	6,907	8	57	23.48	29.90	+ .07	65.1	+ 0.1	84	20	80	41	6	51	43	52	45	61	3.90	+ 2.1	14	4,583	sw.	32	nw.	13	9	13	9	5.5	
Phoenix	1,108	50	56	28.70	29.81	+ .03	88.6	— 1.8	107	30	101	65	17	76	35	69	58	43	2.98	+ 1.9	9	3,528	e.	34	s.	11	9	22	0	4.3	
Yuma	141	9	58	29.65	29.79	+ .03	91.6	+ 0.7	114	30	106	69	1	78	40	73	64	47	1.34	+ 1.2	1	5,257	sw.	29	se.	20	25	5	1	1.6	
Independence	3,910	11	42	25.98	29.87	+ .04	79.1	+ 0.6	101	20	95	55	15	64	36	58	41	29	0.26	+ 0.3	3	4,446	se.	24	se.	13	11	12	8	4.7	
Middle Plateau.							73.7	+ 2.3										40	1.29	+ 0.8									3.7	
Reno	4,532	56	63	25.51	29.91	+ .04	73.3	+ 5.8	99	30	91	48	16	56	42	53	39	39	1.53	+ 1.4	4	3,954	w.	36	sw.	19	22	8	1	2.3	
Tonopah	6,089	12	20	24.16	29.94	.....	75.2	+ 8.7	94	20	87	58	13	63	28	53	34	28	0.92	+ 0.6	9	5,474	se.	32	w.	8	16	14	3	3.6	
Winnemucca	4,344	18	56	25.65	29.96	+ .06	74.0	+ 2.4	98	31	92	48	15	56	43	55	43	40	0.29	+ 0.1	4	3,729	ne.	30	s.	8	23	6	2	2.3	
Modena	5,479	10	43	24.68	29.90	+ .04	72.0	+ 2.3	96	21	88	43	1	56	48	54	40	41	2.76	+ 2.4	8	7,191	w.	36	s.	21	11	11	9	5.0	
Salt Lake City	4,366	105	110	25.66	29.94	+ .04	75.6	— 0.6	94	12	87	58	17	64	32	58	46	39	0.25	— 0.3	4	4,404	se.	38	w.	25	17	13	1	3.4	
Durango	6,546	18	56	23.78	29.95	+ .06	67.4	— 1.3	88	4	84	45	1	51	42	52	45	58	2.39	+ 0.8	15	4,260	nw.	27	n.	3	3	24	4	6.1	
Grand Junction	4,608	43	51	25.42	29.93	+ .04	78.2	— 1.0	97	5	92	54	19	64	35	57	43	35	0.87	+ 0.3	5	3,771	nw.	33	se.	28	15	16	0	3.5	
Northern Plateau.							73.3	+ 2.9										44	0.68	+ 0.2									2.8	
Baker City	3,471	48	58	26.49	30.01	+ .06	68.8	+ 3.8	102	31	84	43	26	54	45	56	48	53	2.08	+ 1.6	6	4,452	nw.	26	n.	25	21	10	0	2.3	
Boise	2,739	78	86	27.16	29.96	+ .03	75.0	+ 2.2	104	31	90	50	5	60	42	56	42	37	0.23	0.0	2	4,291	nw.	40	nw.	13	22	8	1	2.2	
Lewiston	757	10	51	29.18	29.97	+ .02	77.2	+ 3.6	108	31	93	48	26	61	49	.....	.....	.....	0.19	— 0.2	2	5,131	e.	46	n.	22	19	6	6	3.1	
Pocatello	4,477	46	54	25.55	29.97	+ .05	72.2	+ 1.0	95	31	87	47	6	58	40	55	43	41	0.29	— 0.3	4	5,367	se.	30	sw.	4	20	11	0	2.5	
Spokane	1,929	101	110	27.97	29.98	+ .02	71.8	+ 3.0	101	31	86	44	26	58	43	56	44	45	0.83	+ 0.2	3	4,446	sw.	29	w.	15	14	10	7	4.1	
Walla Walla	1,000	71	79	28.92	29.97	.00	78.0	+ 3.9	105	20	92	49	26	64	39	61	49	44	0.49	+ 0.1	2	4,112	s.	24	e.	21	21	8	2	2.3	
N. Pac. Coast Reg.							62.4	+ 1.2										73	0.57	— 0.3									4.2	
Blaine	57	4	....	30.00	30.06	.....	61.8	.....	82	21	74	39	26	50	.....	.....	.....	.....	1.29	.....	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	
North Head	211	11	56	29.89	30.11	+ .03	56.2	— 1.5	65	23	59	49	30	53	12	54	52	87	0.82	+ 0.3	7	11,687	nw.	44	se.	3	11	11	9	5.2	
Port Crescent	259	12	29	29.85	30.13	+ .07	55.4	— 0.9	84	12	63	37	26	42	34	.....	.....	.....	0.27	— 0.3	6	3,493	nw.	13	w.	31	15	11	5	4.3	
Seattle	123	185	224	29.97	30.10	+ .06	65.1	+ 1.6	86	20	74	50	26	56	28	58	54	71	0.24	— 0.4	5	5,937	n.	26	n.	10	15	10	6	4.2	
Tacoma	213	113	120	29.84	30.06	.00	65.2	+ 1.8	87	20	75	47	29	55	30	57	52	66	0.53	— 0.1	5	4,580	n.	21	sw.	3	13	9	9	4.9	

TABLE 1.—*Climatological data for U. S. Weather Bureau stations, July, 1908*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.										Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Direction.	Date.					
N. P. Coast Reg—Cont.																														
Tatoosh Island	86	7	57	30.01	30.11	+ .06	54.6	— 0.5	65	12	59	47	26	50	16	53	51	90	0.61	— 1.2	7	7,733	s.	36	s.	12	12	8	11	5.3	
Portland, Oreg.	153	68	106	29.89	30.05	.00	69.7	+ 3.4	92	7	80	51	5	59	31	61	55	65	0.05	— 0.5	3	5,349	nw.	22	n.	24	15	11	5	3.7	
Roseburg	510	9	57	29.49	30.03	.00	70.4	+ 4.3	101	19	87	45	27	54	47	59	52	60	0.04	— 0.3	2	2,948	nw.	18	**nw.**	16	21	10	0	2.0	
Mid. Pac. Coast Reg.							69.6	+ 1.8										60	0.00	0.0									3.6	
Eureka	62	62	80	29.97	30.04	— .01	55.4	+ 0.1	65	29	60	47	5	51	15	53	52	90	T	— 0.1	0	5,561	nw.	47	n.	5	10	18	3	4.4	
Mount Tamalpais	2,375	11	18	27.52	29.95	.00	72.8	.....	90	31	80	47	13	66	21	55	40	34	0.00	0.0	0	11,274	nw.	52	nw.	31	30	1	0	0.6	
Point Reyes Light	490	7	18	29.41	29.93	.....	53.8	.....	70	17	58	46	1	50	20	.....	.....	.....	0.00	.....	0	13,854	nw.	61	nw.	1	5	4	22	7.6	
Red Bluff	332	50	56	29.48	29.82	— .07	86.3	+ 4.2	114	30	102	62	13	70	41	64	47	32	T.	0.0	0	3,386	se.	26	nw.	5	28	3	0	0.9	
Sacramento	69	106	117	29.79	29.86	— .02	75.8	+ 3.3	103	31	93	54	3	59	42	62	54	55	T.	0.0	0	6,384	s.	22	s.	25	30	1	0	0.5	
San Francisco	155	200	204	29.78	29.95	.00	57.3	0.0	77	17	63	48	2	52	21	53	51	87	0.02	0.0	1	8,793	w.	34	**sw.**	24	11	17	3	4.5	
San Jose	141	78	88	29.78	29.93	.....	68.1	+ 1.2	96	16	82	49	3	54	47	.....	.....	.....	0.00	0.0	0	4,470	nw.	24	se.	5	30	1	0	1.5	
Southeast Farallon	30	9	17	29.93	29.96	.....	53.4	.....	62	17	56	47	3	51	11	.....	.....	.....	0.00	0.0	0	9,292	nw.	38	nw.	1	3	7	21	8.0	
S. Pac. Coast Reg.							71.9	+ 2.0										61	0.00	0.0									2.3	
Fresno	330	67	70	29.50	29.84	+ .01	86.5	+ 4.5	114	31	105	57	12	68	42	60	38	23	0.01	0.0	1	4,350	nw.	22	s.	31	26	5	0	1.2	
Los Angeles	338	116	123	29.55	29.91	+ .01	70.2	+ 2.8	92	31	81	52	15	59	30	60	56	71	T.	0.0	0	3,833	w.	20	sw.	18	25	6	0	2.1	
San Diego	87	94	102	29.84	29.93	+ .01	66.8	— 0.1	80	17	71	56	2	62	18	62	60	80	0.00	0.0	0	4,534	nw.	22	nw.	8	24	6	1	2.9	
San Luis Obispo	201	47	54	29.76	29.97	+ .02	64.2	+ 1.0	87	17	77	45	2	51	35	56	51	71	0.00	0.0	0	2,860	nw.	15	w.	12	26	5	0	2.9	
West Indies.																														
Grand Turk	11	6	20	30.04	30.05	+ .03	82.9	.....	92	24	89	70	12	76	.....	.....	.....	.....	1.11	.....	10	.....	e.	.....	.....	.....	.....	.....	.....	.....	
San Juan	82	48	90	29.95	30.04	+ .05	81.0	.....	90	25	87	71	13	75	15	75	73	77	5.32	— 0.4	18	8,140	se.	37	se.	26	12	17	2	4.3	
Panama.																														
Christobal	74	.....	.....	29.86	29.88	.....	78.3	.....	86	8	82	70	16	74	15	76	74	89	14.76	.....	27	5,844	w.	40	s.	16	2	14	15	7.1	
Bas Obispo	40	.....	.....	29.70	29.88	.....	78.0	.....	90	13	85	69	11	72	19	74	73	93	9.14	.....	25	2,987	nw.	25	se.	11	0	4	27	8.2	
Ancon	.....	.....	.....	29.78	29.86	.....	79.8	.....	93	13	87	69	11	73	19	74	73	88	6.83	.....	22	5,098	nw.	24	sw.	16	2	14	15	7.1	
Alhajuela	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	68	12	72	.....	.....	.....	.....	9.68	.....	26	1,030	sw.	13	ne.	19	.....	.....	.....	.....	
Bohio	.....	.....	.....	.....	.....	.....	78.4	.....	89	13	85	69	17	72	18	.....	.....	.....	7.78	.....	28	1,337	sw.	18	se.	14	.....	.....	.....	.....	
Gatun	.....	.....	.....	.....	.....	.....	78.0	.....	87	26	84	69	25	72	17	.....	.....	.....	13.67	.....	27	2,840	s.	20	s.	16	.....	.....	.....	.....	

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.80 inch in 1 hour, during July, 1908, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Abilene, Tex	6	4:30 p. m.	6:10 p. m.	1.01	4:48 p. m.	5:12 p. m.	0.05	0.32	0.62	0.78	0.86	0.91	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	25	2:10 p. m.	2:55 p. m.	0.89	2:10 p. m.	2:35 p. m.	0.00	0.20	0.46	0.61	0.77	0.84	.....	.....	.....	.....	.....	.....	.....	.....	.....
Amarillo, Tex	1	8:45 p. m.	11:03 p. m.	1.07	9:00 p. m.	9:20 p. m.	0.02	0.31	0.69	0.88	0.95	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Anniston, Ala	6	4:35 p. m.	D. N. p. m.	1.53	4:39 p. m.	5:24 p. m.	0.01	0.17	0.35	0.50	0.67	0.76	0.86	0.97	1.05	1.11	.....	.....	.....	.....	.....
Asheville, N. C	23	3:10 a. m.	8:30 a. m.	1.65	3:16 a. m.	4:09 a. m.	0.01	0.10	0.21	0.31	0.51	0.68	0.80	0.99	1.17	1.21	1.30	1.39	.....	.....	.....
Atlanta, Ga	5	2:55 p. m.	8:25 p. m.	2.36	3:49 p. m.	4:39 p. m.	0.19	0.14	0.29	0.43	0.72	1.03	1.28	1.44	1.54	1.68	1.82	.....	.....	.....	.....
Do	9	10:00 a. m.	12:55 p. m.	1.59	10:12 a. m.	11:07 a. m.	0.02	0.13	0.34	0.55	0.75	0.75	0.79	1.01	1.14	1.24	1.35	1.46	.....	.....	.....
Atlantic City, N. J	25	9:02 a. m.	10:20 a. m.	1.25	9:24 a. m.	9:44 a. m.	0.01	0.24	0.49	0.84	1.10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Baker City, Oreg	13	2:40 p. m.	4:20 p. m.	0.95	3:05 p. m.	3:35 p. m.	0.06	0.08	0.20	0.36	0.50	0.66	0.78	.....	.....	.....	.....	.....	.....	.....	.....
Binghamton, N. Y	24–25	3:45 p. m.	1:45 a. m.	2.13	5:04 p. m.	5:54 p. m.	0.12	0.09	0.31	0.39	0.40	0.46	0.50	0.52	0.55	0.64	0.70	.....	.....	.....	.....
Charleston, S. C	29	1:40 a. m.	6:05 a. m.	1.76	2:10 a. m.	2:50 a. m.	0.05	0.12	0.27	0.49	0.71	0.83	0.89	1.00	1.12	.....	.....	.....	.....	.....	.....
Charles City, Iowa	16	7:03 p. m.	7:55 p. m.	1.58	7:04 p. m.	7:33 p. m.	0.02	0.16	0.45	0.85	1.09	1.39	1.54	.....	.....	.....	.....	.....	.....	.....	.....
Do	16–17	11:15 p. m.	4:05 a. m.	0.94	11:15 p. m.	11:40 p. m.	0.00	0.20	0.34	0.41	0.53	0.58	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cheyenne, Wyo	22	3:25 p. m.	4:30 p. m.	0.83	3:50 p. m.	4:15 p. m.	0.08	0.11	0.36	0.54	0.67	0.73	.....	.....	.....	.....	.....	.....	.....	.....	.....
Columbia, Mo	24	12:42 p. m.	2:28 p. m.	1.55	1:12 p. m.	1:37 p. m.	0.09	0.63	0.99	1.22	1.31	1.37	.....	.....	.....	.....	.....	.....	.....	.....	.....
Columbus, Ohio	24	7:10 a. m.	10:30 a. m.	1.96	7:38 a. m.	8:08 a. m.	0.23	0.19	0.53	1.00	1.17	1.30	1.35	.....	.....	.....	.....	.....	.....	.....	.....
Concordia, Kans	12–13	9:05 p. m.	2:00 a. m.	1.70	9:07 p. m.	9:59 p. m.	0.01	0.31	0.48	0.60	0.68	0.74	0.94	1.08	1.15	1.30	1.40	.....	.....	.....	.....
Do	22	7:01 p. m.	9:15 p. m.	1.30	7:21 p. m.	7:50 p. m.	0.06	0.17	0.59	0.77	0.96	1.09	1.14	.....	.....	.....	.....	.....	.....	.....	.....
Davenport, Iowa	4	2:50 a. m.	5:00 a. m.	1.17	2:56 a. m.	3:16 a. m.	0.01	0.30	0.47	0.82	1.10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Duluth, Minn	27	2:25 p. m.	5:25 p. m.	1.58	2:33 p. m.	3:13 p. m.	0.02	0.16	0.36	0.57	0.77	0.91	1.08	1.25	1.33	.....	.....	.....	.....	.....	.....
Elkins, W. Va	3	4:45 p. m.	10:50 p. m.	1.34	4:48 p. m.	5:18 p. m.	0.01	0.53	0.75	0.89	0.95	1.03	1.15	.....	.....	.....	.....	.....	.....	.....	.....
El Paso, Tex	2	8:40 p. m.	9:25 p. m.	1.13	8:52 p. m.	9:17 p. m.	0.03	0.23	0.42	0.64	0.96	1.09	.....	.....	.....	.....	.....	.....	.....	.....	.....
Flagstaff, Ariz	16–17	11:55 a. m.	D. N. a. m.	1.05	12:19 p. m.	12:45 p. m.	0.01	0.08	0.24	0.35	0.47	0.58	0.70	0.76	.....	.....	.....	.....	.....	.....	.....
Fort Smith, Ark	19	6:03 a. m.	11:16 p. m.	2.86	7:41 a. m.	8:06 a. m.	0.10	0.16	0.25	0.35	0.44	0.48	.....	.....	.....	.....	.....	.....	.....	.....	.....
					6:42 p. m.	7:12 p. m.	0.95	0.08	0.16	0.31	0.38	0.43	0.50	.....	.....	.....	.....	.....	.....	.....	.....
Do	23	1:46 p. m.	4:51 p. m.	1.76	1:58 p. m.	2:31 p. m.	0.01	0.23	0.73	1.13	1.26	1.36	1.45	1.52	.....	.....	.....	.....	.....	.....	.....
Galveston, Tex	2	3:45 a. m.	5:45 a. m.	1.91	4:04 a. m.	5:05 a. m.	0.03	0.29	0.42	0.68	0.79	0.80	0.86	1.00	1.03	1.13	1.44	1.82	1.88	.....	.....
Do	2	6:55 a. m.	9:10 a. m.	1.36	7:02 a. m.	7:29 a. m.	0.03	0.18	0.48	0.81	1.02	1.20	1.24	.....	.....	.....	.....	.....	.....	.....	.....
Hartford, Conn	3	2:33 p. m.	4:10 p. m.	1.40	2:39 p. m.	3:09 p. m.	0.01	0.22	0.63	0.87	1.06	1.17	1.27	.....	.....	.....	.....	.....	.....	.....	.....
Huron, S. Dak	4–5	10:45 p. m.	D. N. a. m.	1.05	12:55 a. m.	1:45 a. m.	0.31	0.11	0.18	0.20	0.21	0.31	0.45	0.52	0.61	0.65	0.71	.....	.....	.....	.....
Do	25	D. N. a. m.	5:50 a. m.	0.93	5:23 a. m.	5:32 a. m.	0.53	0.20	0.34	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	25	2:20 p. m.	4:12 p. m.	0.78	2:48 p. m.	3:28 p. m.	0.05	0.22	0.34	0.37	0.40	0.45	0.49	0.54	0.66	.....	.....	.....	.....	.....	.....
Lincoln, Nebr	5–6	10:35 p. m.	6:00 a. m.	4.55	10:45 p. m.	11:35 p. m.	0.03	0.15	0.27	0.59	0.80	1.00	1.17	1.40	1.59	1.70	1.80	.....	.....	.....	.....
					11:35 p. m.	12:25 a. m.	.....	1.87	1.89	1.91	1.93	1.97	2.02	2.15	2.39	2.50	2.53	.....	.....	.....	.....
					12:25 a. m.	1:15 a. m.	.....	2.58	2.65	2.72	2.84	2.91	3.02	3.15	3.21	3.31	3.45	.....	.....	.....	.....
					1:15 a. m.	1:30 a. m.	.....	3.59	3.78	3.86	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Louisville, Ky	23	9:48 p. m.	10:40 p. m.	1.23	9:49 p. m.	10:23 p. m.	0.01	0.09	0.14	0.33	0.60	0.72	0.95	1.20	.....	.....	.....	.....	.....	.....	.....
Do	26	10:00 a. m.	2:15 p. m.	1.20	10:59 a. m.	11:33 a. m.	0.08	0.08	0.20	0.30	0.41	0.54	0.62	0.70	.....	.....	.....	.....	.....	.....	.....
Lynchburg, Va.*	25	8:45 p. m.	11:00 p. m.	2.04	9:00 p. m.	11:00 p. m.	T.	0.08*	0.16*	0.25*	0.38*	0.46*	0.54*	0.62*	0.70*	0.78*	0.86*	1.02*	1.36*	1.70*	2.04
Macon, Ga	9	3:10 p. m.	6:40 p. m.	1.21	3:40 p. m.	4:19 p. m.	0.01	0.12	0.33	0.42	0.56	0.63	0.84	1.01	1.08	.....	.....	.....	.....	.....	.....
Do	18	3:20 p. m.	5:30 p. m.	1.16	4:18 p. m.	4:44 p. m.	0.08	0.13	0.30	0.42	0.63	0.97	.....	.....	.....	.....	.....	.....	.....	.....	.....
Memphis, Tenn	24	5:55 p. m.	9:15 p. m.	1.48	6:18 p. m.	6:49 p. m.	0.02	0.27	0.53	0.68	0.90	1.06	1.19	1.25	.....	.....	.....	.....	.....	.....	.....
Meridian, Miss	4	7:45 a. m.	10:50 a. m.	1.53	8:25 a. m.	9:13 a. m.	0.22	0.25	0.44	0.50	0.51	0.54	0.68	0.79	1.00	1.13	1.18	.....	.....	.....	.....
Milwaukee, Wis	6	4:55 p. m.	6:10 p. m.	1.32	5:04 p. m.	5:46 p. m.	0.01	0.16	0.23	0.35	0.70	0.90	1.15	1.18	1.25	1.28	.....	.....	.....	.....	.....
Mobile, Ala	31	D. N. a. m.	6:15 a. m.	1.41	5:23 a. m.	5:52 a. m.	0.31	0.08	0.12	0.35	0.70	1.02	1.09	.....	.....	.....	.....	.....	.....	.....	.....
Modena, Utah	26	1:22 p. m.	6:04 p. m.	1.20	1:30 p. m.	2:06 p. m.	0.01	0.08	0.29	0.49	0.74	0.90	1.00	1.06	1.09	.....	.....	.....	.....	.....	.....
Do	27	8:02 p. m.	10:15 p. m.	1.01	8:09 p. m.	8:40 p. m.	0.03	0.07	0.12	0.32	0.58	0.71	0.80	0.82	.....	.....	.....	.....	.....	.....	.....
Montgomery, Ala	4	1:35 p. m.	2:55 p. m.	1.33	2:26 p. m.	2:42 p. m.	0.24	0.45	0.98	1.07	1.08	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	19	5:10 p. m.	6:25 p. m.	1.27	5:22 p. m.	5:52 p. m.	0.01	0.14	0.43	0.80	1.01	1.12	1.25	.....	.....	.....	.....	.....	.....	.....	.....
Moorhead, Minn	27	5:10 a. m.	7:15 a. m.	1.52	5:19 a. m.	6:03 a. m.	0.02	0.13	0.21	0.34	0.44	0.60	0.80	1.15	1.32	1.38	.....	.....	.....	.....	.....
New Haven, Conn	21–22	8:50 p. m.	9:10 a. m.	2.72	9:44 p. m.	10:09 p. m.	0.03	0.10	0.35	0.49	0.63	0.68	.....	.....	.....	.....	.....	.....	.....	.....	.....
					11:12 p. m.	11:27 p. m.	1.03	0.09	0.34	0.51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
					4:14 a. m.	4:34 a. m.	2.06	0.09	0.24	0.48	0.61	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
New York, N. Y	14	4:36 p. m.	6:59 p. m.	1.44	4:42 p. m.	5:16 p. m.	T.	0.17	0.46	0.53	0.83	0.97	1.12	1.19	.....	.....	.....	.....	.....	.....	.....

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated.												
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Norfolk, Va	28	11:07 a. m.	2:15 p. m.	1.94	11:09 a. m.	11:49 a. m.	*0.01	*0.28	*0.62	*0.83	*0.95	*1.15	*1.39	*1.57	*1.66	.....	.....	.....	.....	.....	.....
Omaha, Nebr	5–6	7:42 p. m.	6:25 a. m.	1.88	7:52 p. m.	8:32 p. m.	0.01	0.06	0.13	0.22	0.39	0.62	0.83	0.87	1.01	.....	.....	.....	.....	.....	.....
Pensacola, Fla	24	4:04 p. m.	7:05 p. m.	1.53	4:12 p. m.	5:11 p. m.	0.01	0.10	0.18	0.43	0.66	0.81	0.94	1.00	1.06	1.10	1.16	1.28	.....	.....	.....
Do	30	2:10 p. m.	6:10 p. m.	1.22	2:45 p. m.	3:01 p. m.	0.05	0.39	0.79	1.09	1.13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Phoenix, Ariz	17–18	8:34 p. m.	2:25 a. m.	1.41	9:11 p. m.	9:38 p. m.	0.07	0.18	0.46	0.78	0.99	1.11	1.15	.....	.....	.....	.....	.....	.....	.....	.....
Pierre, S. Dak	5	2:30 a. m.	4:10 a. m.	1.20	2:41 a. m.	3:00 a. m.	0.03	0.36	0.73	0.99	1.08	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pittsburg, Pa	24	4:15 p. m.	10:45 p. m.	1.36	4:37 p. m.	5:17 p. m.	0.01	0.18	0.31	0.42	0.58	0.68	0.82	0.95	1.03	.....	.....	.....	.....	.....	.....
Raleigh, N. C	27–28	5:33 p. m.	D. N. a. m.	1.16	6:14 p. m.	6:39 p. m.	0.01	0.11	0.35	0.61	0.71	0.77	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	30	D. N. a. m.	8:05 a. m.	1.09	6:19 a. m.	6:49 a. m.	0.10	0.09	0.19	0.34	0.43	0.66	0.81	.....	.....	.....	.....	.....	.....	.....	.....
Richmond, Va	4	8:38 p. m.	9:30 p. m.	0.95	8:38 p. m.	9:03 p. m.	0.00	0.20	0.45	0.66	0.80	0.92	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	23	12:05 p. m.	1:36 p. m.	0.80	12:33 p. m.	1:11 p. m.	0.18	0.09	0.27	0.32	0.35	0.38	0.45	0.53	0.06	.....	.....	.....	.....	.....	.....
St. Louis, Mo	6	1:35 p. m.	2:30 p. m.	1.09	1:44 p. m.	2:08 p. m.	0.01	0.12	0.34	0.72	1.05	1.08	.....	.....	.....	.....	.....	.....	.....	.....	.....
Savannah, Ga	8	1:38 p. m.	2:50 p. m.	1.20	1:41 p. m.	2:21 p. m.	0.02	0.17	0.29	0.78	0.93	0.99	1.04	1.12	1.17	.....	.....	.....	.....	.....	.....
Do	9	3:56 p. m.	D. N. p. m.	1.33	7:47 p. m.	8:20 p. m.	0.20	0.06	0.21	0.37	0.52	0.66	0.72	0.77	.....	.....	.....	.....	.....	.....	.....
Do	28	10:06 p. m.	D. N. p. m.	0.96	10:06 p. m.	10:41 p. m.	0.00	0.09	0.16	0.17	0.35	0.70	0.87	0.92	.....	.....	.....	.....	.....	.....	.....
Shreveport, La	30	3:45 p. m.	4:40 p. m.	1.67	3:50 p. m.	4:31 p. m.	0.01	0.16	0.30	0.30	0.39	0.96	1.22	1.45	1.63	1.66	.....	.....	.....	.....	.....
Sioux City, Iowa	5–6	11:15 p. m.	10:10 a. m.	1.46	2:38 a. m.	3:08 a. m.	0.39	0.06	0.16	0.36	0.56	0.77	0.86	.....	.....	.....	.....	.....	.....	.....	.....
Thomasville, Ga	7	5:15 p. m.	6:05 p. m.	1.00	5:21 p. m.	5:52 p. m.	0.01	0.09	0.37	0.56	0.70	0.89	0.97	0.98	.....	.....	.....	.....	.....	.....	.....
Do	12	12:36 p. m.	5:52 p. m.	1.94	12:41 p. m. 2:00 p. m.	12:49 p. m. 2:35 p. m.	0.01 0.83	0.29 0.11	0.32 0.31	..... 0.64	..... 0.79	..... 0.36	..... 0.92	..... 0.96	.....	.....	.....	.....	.....	.....	.....
Toledo, Ohio	24	12:42 p. m.	4:50 p. m.	1.63	1:35 p. m.	2:15 p. m.	0.07	0.16	0.26	0.37	0.45	0.56	0.72	0.83	0.92	.....	.....	.....	.....	.....	.....
Topeka, Kans	6	1:45 p. m.	4:50 p. m.	0.97	1:54 p. m.	2:11 p. m.	0.05	0.21	0.47	0.66	0.71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	23	2:58 p. m.	8:15 p. m.	1.42	3:12 p. m.	3:38 p. m.	0.09	0.12	0.22	0.38	0.62	0.80	0.84	.....	.....	.....	.....	.....	.....	.....	.....
Wilmington, N. C	9	7:35 a. m.	1:50 p. m.	3.46	7:38 a. m. 9:33 a. m. 12:01 p. m.	8:40 a. m. 10:17 a. m. 12:33 p. m.	0.01 1.39 2.57	0.09 0.07 0.07	0.14 0.13 0.21	0.18 0.16 0.24	0.34 0.23 0.32	0.55 0.32 0.52	0.71 0.40 0.68	0.74 0.56 0.75	0.76 0.76	0.86 0.85	1.02	1.24	1.33	.....	.....
Wythville, Va	21	12:58 p. m.	4:05 p. m.	2.45	1:00 p. m.	1:38 p. m.	T.	0.24	0.68	1.17	1.59	1.79	2.10	2.22	2.32	.....	.....	.....	.....	.....	.....
Do	27	1:33 p. m.	3:45 p. m.	0.90	1:35 p. m.	2:00 p. m.	0.01	0.18	0.35	0.50	0.61	0.67	.....	.....	.....	.....	.....	.....	.....	.....	.....
Yankton, S. Dak	12	5:10 a. m.	3:20 p. m.	2.71	5:50 a. m. 10:35 a. m.	6:15 a. m. 11:05 a. m.	0.25 1.50	0.12 0.10	0.32 0.30	0.40 0.49	0.45 0.61	0.50 0.72	..... 0.83	.....	.....	.....	.....	.....	.....	.....	.....

*Partly estimated.

TABLE III.—*Data furnished by the Canadian Meteorological Service, July, 1908.*

Stations.	Pressure.			Temperature.				Precipitation.			Stations.	Pressure.			Temperature.				Precipitation.		
	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	Total snowfall.		Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	Total snowfall.
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*		*Ins.*	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
St. Johns, N. F.	29.86	29.99	+.02	60.5	+ 1.2	69.8	51.2	2.70	—1.19	.....	Parry Sound, Ont	29.36	30.04	+.08	69.1	+ 3.1	80.1	58.1	2.31	—0.31	....
Sydney, C. B. I.	29.97	30.01	+.08	66.1	+ 3.8	76.5	55.6	3.04	—0.61	.....	Port Arthur, Ont	29.31	30.02	+.08	62.6	+ 0.6	74.0	51.1	1.96	—1.52	....
Halifax, N. S.	29.92	30.02	+.06	67.1	+ 3.7	77.6	56.6	5.69	+1.64	.....	Winnipeg, Man	29.15	29.97	+.04	66.9	+ 0.9	79.7	54.1	1.76	—1.32	....
Grand Manan, N. B	29.93	29.98	+.05	64.9	+ 3.2	73.5	56.2	3.31	+0.31	.....	Minnedosa, Man	28.18	29.96	+.03	64.7	+ 2.5	77.4	52.0	3.20	+0.60	....
Yarmouth, N. S	29.97	30.04	+.09	61.7	+ 2.2	69.3	54.1	3.39	—0.23	.....	Regina, Sask	28.05	.....	.....	66.6	+ 3.1	81.7	51.5	0.87	—1.61	....
Charlottetown, P. E. I.	29.93	29.97	+.07	68.2	+ 4.1	76.8	59.6	4.28	+0.79	.....	Medicine Hat, Alberta	27.69	29.91	+.01	71.3	+ 3.5	86.1	56.6	1.85	—0.24	....
Chatham, N. B	29.93	29.95	+.07	70.7	+ 5.7	83.9	57.5	1.54	—2.65	.....	Swift Current, Sask	27.44	29.95	+.04	68.2	+ 1.7	82.8	53.5	0.68	—1.76	....
Father Point, Que	29.90	29.92	+.07	61.0	+ 3.4	70.2	51.8	1.27	—1.77	.....	Calgary, Alberta	26.47	29.93	+.03	63.7	+ 3.1	78.1	49.3	1.73	—0.95	....
Quebec, Que	29.65	29.97	+.06	69.9	+ 4.4	80.2	59.6	3.28	—0.98	.....	Banff, Alberta	25.46	29.98	+.08	59.5	+ 2.9	74.8	44.2	1.06	—2.18	....
Montreal, Que	29.78	29.98	+.05	71.8	+ 3.3	79.9	63.7	4.39	+0.10	.....	Edmonton, Alberta	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
Rockliffe, Ont.	29.39	29.99	+.05	65.5	— 0.1	76.8	54.2	2.86	—0.26	.....	Prince Albert, Sask	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
Ottawa, Ont	29.74	30.06	+.12	71.9	+ 2.4	82.7	61.1	2.63	—0.84	.....	Battleford, Sask	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
Kingston, Ont	29.75	30.06	+.09	69.2	+ 1.0	76.3	62.2	5.56	+2.67	.....	Kamloops, B. C.	28.67	29.86	—.08	72.1	+ 3.6	85.1	59.1	0.48	—1.13	....
Toronto, Ont	29.67	30.03	+.06	70.7	+ 2.7	81.6	59.8	2.93	+0.01	.....	Victoria, B. C.	29.97	30.06	+.01	62.6	+ 2.6	73.1	52.2	0.15	—0.25	....
White River, Ont	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Barkerville, B. C.	25.76	30.04	+.13	56.5	+ 1.4	69.2	43.8	4.52	+1.50	....
Port Stanley, Ont	29.42	30.05	+.07	69.2	+ 1.4	79.0	59.6	3.02	—0.02	.....	Hamilton, Bermuda	30.02	30.18	+.04	80.0	+ 1.3	85.8	74.1	2.14	—2.30	....
Southampton, Ont.	29.35	.....	.....	67.4	+ 2.7	76.4	58.4	2.07	+0.09	.....	Dawson, Yukon	.....	.....	.....	.....	.....	.....	.....	.....	.....	....

TABLE IV.—*Heights of rivers referred to zeros of gages, July, 1908.*

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.	Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.						Height.	Date.	Height.	Date.		
Republican River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*	*South Fork Holston River.*	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Clay Center, Kans.	42	18	14.8	25	7.3	13	9.7	7.5	Bluff City, Tenn.	35	12	2.1	7	0.7	26,27	1.2	1.4
Smoky Hill-Kansas River.									*Holston River.*								
Abilene, Kans.	254	22	11.4	1	4.9	14	7.5	6.5	Rogersville, Tenn.	103	14	4.3	9	1.9	28	2.6	2.4
Manhattan, Kans.	160	18	12.8	16	5.8	31	8.5	7.0	*French Broad River.*								
Topeka, Kans.	87	21	17.0	1	9.3	31	11.7	7.7	Asheville, N. C.	144	4	1.9	6	— 0.3	1,2	0.4	2.2
Missouri River.									Dandridge, Tenn.	46	12	4.5	9	0.9	1-3,23,27	1.6	3.6
Townsend, Mont.	2,504	11	8.1	1-4,6	4.9	29-31	6.5	3.2	*Tennessee River.*								
Fort Benton, Mont.	2,285	12	7.5	1,2	3.6	31	5.4	3.9	Knoxville, Tenn.	635	12	5.9	9	1.1	{1-3,23,24,27,28}	2.2	4.8
Wolfpoint, Mont.	1,952	17	5.8	1	1.1	31	3.4	4.7	Loudon, Tenn.	590	25	5.2	9	1.5	3,23,28	2.4	3.7
Bismarck, N. Dak.	1,309	14	10.0	3	5.9	27	8.1	4.1	Kingston, Tenn.	556	25	5.2	9	1.9	3	3.1	3.3
Pierre, S. Dak.	1,114	14	8.3	5	5.6	28	7.2	2.7	Chattanooga, Tenn.	452	33	7.3	10,11	2.8	3,29	4.3	4.5
Sioux City, Iowa	784	17	12.4	1	9.6	31	11.1	2.8	Bridgeport, Ala	402	24	5.3	11	1.3	30	2.7	4.0
Blair, Nebr.	705	15	13.8	1	9.7	31	11.8	4.1	Guntersville, Ala.	349	31	8.2	12	3.1	30,31	4.9	5.1
Omaha, Nebr.	669	18	17.2	1	12.8	31	14.9	4.4	Florence, Ala.	255	16	4.6	13	1.0	29-31	2.3	3.6
Plattsmouth, Nebr.	641	17	10.0	1	5.7	31	7.7	4.3	Riverton, Ala.	225	26	7.5	13	2.8	31	4.7	4.7
St. Joseph, Mo.	481	10	14.0	1	7.5	30,31	10.0	6.5	Johnsonville, Tenn.	95	21	6.9	17	2.8	31	4.6	4.1
Kansas City, Mo.	388	21	26.5	2	14.2	31	18.9	12.3	*Ohio River.*								
Glasgow, Mo.	231	21	24.7	1	14.9	31	18.9	9.8	Pittsburg, Pa.	966	22	7.3	26,28	4.2	5	5.8	3.1
Boonville, Mo.	199	20	24.0	2	14.7	31	18.3	9.3	Cornopolis, Pa.	956	25	10.3	3	5.3	5	8.1	5.0
Hermann, Mo.	103	24	21.4	5	13.4	31	16.9	8.0	Beaver Dam, Pa.	937	27	8.9	26	3.0	3	5.4	5.9
Minnesota River.									Wheeling, W. Va.	875	36	8.2	23	2.6	4	4.8	5.6
Mankato, Minn.	127	18	17.0	1	7.8	26	11.8	9.2	Parkersburg, W. Va.	785	36	8.7	29	3.4	5	5.9	5.3
St. Croix River.									Point Pleasant, W. Va.[1]	703	39	10.2	29	2.7	15	5.5	7.5
Stillwater, Minn.	23	11	14.8	1	7.6	31	10.8	7.2	Huntington, W. Va	660	50	13.8	29,30	4.9	17	8.7	8.9
Illinois River.									Catlettsburg, Ky.	651	50	13.1	30	4.0	16	7.7	9.1
La Salle, Ill.	197	18	15.1	4	12.6	31	13.9	2.5	Portsmouth, Ohio	612	50	13.5	30	5.5	17	8.5	8.0
Peoria, Ill.	135	14	12.5	1	9.4	31	10.9	3.1	Maysville, Ky.	559	50	13.6	31	6.2	18	8.7	7.4
Conemaugh River.									Cincinnati, Ohio	499	50	15.2	31	7.4	20	10.0	7.8
Johnstown, Pa	64	7	2.4	25	0.7	9-13	0.9	1.7	Madison, Ind	413	46	10.6	31	6.9	20	8.7	3.7
Allegheny River.									Louisville, Ky.	367	28	6.1	31	3.7	21	4.6	2.4
Warren, Pa.	177	14	3.0	26	0.5	14-21	1.0	2.5	Evansville, Ind.	184	35	8.2	1	5.7	23	7.2	2.5
Parker, Pa.	73	20	3.5	5	1.0	13,18,21	1.7	2.5	Mount Vernon, Ind.	148	35	8.0	1,2	5.7	24	7.1	2.3
Freeport, Pa.	29	20	7.1	5	2.2	13	3.6	4.9	Paducah, Ky.	47	40	18.7	1	8.8	27,31	13.3	9.9
Springdale, Pa	17	—	11.1	23	6.6	13	7.9	4.5	Cairo, Ill.	1	45	33.5	1	22.4	31	27.6	11.1
Youghiogheny River.									*Neosho River.*								
Confluence, Pa.	59	10	1.3	25	0.1	11-14,21	0.4	1.2	Iola, Kans.	262	10	6.9	4	0.2	21-23,31	1.7	6.7
West Newton, Pa.	15	23	2.5	25	0.2	6	0.9	2.3	Oswego, Kans.	184	20	13.4	1	1.0	28	4.0	12.4
Monongahela River.									Fort Gibson, Okla.	3	22	12.0	2,3	9.7	12	10.6	2.3
Fairmont, W. Va.	119	25	16.4	27	12.8	2,3	14.7	3.6	*Canadian River.*								
Greensboro, Pa.	81	18	10.5	27	6.6	1,4	7.3	3.9	Calvin, Okla.	99	10	4.9	1,2	2.9	17,18	3.5	2.0
Lock No. 4, Pa.	40	28	11.5	28	6.7	4,5	7.7	4.8	*Black River.*								
Muskingum River.									Blackrock, Ark.	67	12	6.7	1	3.9	24,31	4.6	2.8
Zanesville, Ohio	70	25	9.0	18	8.0	5,6	8.3	1.0	*White River.*								
Little Kanawha River.									Calicorock, Ark	272	18	1.6	1	0.5	18,19	0.9	1.1
Creston, W. Va.	38	20	4.2	28	1.7	1	2.5	2.5	Batesville, Ark.	217	18	3.8	1-3	2.5	20-23,27,31	2.9	1.3
New-Great Kanawha River.									Clarendon, Ark.	75	30	21.0	1	10.6	30,31	15.0	10.4
Hinton, W. Va.	153	14	4.0	6	2.0	17-19	2.7	2.0	*Arkansas River.*								
Charleston, W. Va.	58	30	8.7	7,28	5.3	31	7.1	3.4	Wichita, Kans.	332	10	1.8	5	— 1.4	28,31	—0.2	3.2
Scioto River.									Tulsa, Okla.	551	16	11.4	5	3.4	29	5.6	8.0
Columbus, Ohio	110	17	2.8	25	1.8	17,27	2.2	1.0	Webbers Falls, Okla.	465	23	14.6	6	6.8	30,31	8.9	7.8
Licking River.									Fort Smith, Ark.	403	22	15.3	6	5.7	31	9.0	9.6
Falmouth, Ky.	30	25	6.0	7	0.5	20,21	1.9	5.5	Dardanelle, Ark.	256	21	15.9	7	6.6	31	10.1	9.3
Kentucky River.									Little Rock, Ark.	176	23	16.7	8	6.8	31	10.7	9.9
Beattyville, Ky	254	30	0.8	19	0.0	12-14	0.3	0.8	Pine Bluff, Ark.	121	25	19.5	9	10.5	31	14.1	9.0
Frankfort, Ky.	65	31	6.8	21	5.6	2,28	5.9	1.2	*Yazoo River.*								
Wabash River.									Greenwood, Miss.	175	38	8.3	1	4.8	21	6.3	3.5
Mount Carmel, Ill.	75	15	3.5	1	2.1	21	2.7	1.4	Yazoo City, Miss.	80	25	20.6	1	2.8	31	13.3	17.8
Cumberland River.									*Ouachita River.*								
Burnside, Ky.	518	50	4.1	21	0.0	2,3	1.7	4.1	Camden, Ark.	304	39	6.6	1	4.6	20	5.4	2.0
Celina, Tenn.	353	45	5.8	8	1.6	3,6	3.3	4.2	Monroe, La.	122	40	31.2	1	17.5	31	24.4	13.7
Carthage, Tenn.	308	40	5.5	8	1.2	1	2.7	4.3	*Red River*								
Nashville, Tenn.	193	40	10.8	8	7.5	1,2	8.7	3.3	Dennison, Tex.	768	22	.....	.....	.....	.....	.....	.....
Clarksville, Tenn.	126	43	9.5	10	3.5	27	5.6	6.0	Arthur City, Tex.	688	27	19.5	5	9.9	31	12.9	9.6
Clinch River.									Fulton, Ark.	515	28	27.7	1	15.5	21	20.8	12.2
Speers Ferry, Va.	156	20	1.4	8	0.1	6	0.6	1.3	Shreveport, La.	327	29	29.4	1	9.4	28	16.8	20.0
Clinton, Tenn.	52	25	6.0	20	3.2	29	4.4	2.8	Alexandria, La.	118	36	41.8	6	22.6	31	34.9	19.2

TABLE IV.—*Heights of rivers referred to zeros of gages*—Continued.

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Fort Ripley, Minn	2,082	10	8.2	1	5.6	20	6.4	2.6
St. Paul, Minn	1,954	14	16.4	1	7.4	31	11.0	9.0
Red Wing, Minn	1,914	14	11.6	1,2	5.1	31	8.0	6.5
Reeds Landing, Minn	1,884	12	10.3	1,2	5.0	31	7.4	5.3
La Crosse, Wis	1,819	12	11.7	4	6.5	31	9.4	5.2
Prairie du Chien, Wis	1,759	18	13.7	7,8	7.5	31	11.5	6.2
Dubuque, Iowa	1,699	18	14.9	19	8.5	31	12.9	6.4
Clinton, Iowa	1,629	16	13.9	20	8.3	31	12.4	5.6
Leclaire, Iowa	1,609	10	8.6	20	4.7	31	7.5	3.9
Davenport, Iowa	1,593	15	12.2	20,21	7.4	31	11.0	4.8
Muscatine, Iowa	1,562	16	13.5	21,22	8.6	31	12.5	4.9
Galland, Iowa	1,472	8	6.9	2	4.8	31	6.4	2.1
Keokuk, Iowa	1,463	15	13.1	1	8.7	31	11.6	4.4
Warsaw, Ill	1,458	18	16.2	1	11.9	31	14.6	4.3
Hannibal, Mo	1,402	13	14.8	1,2	10.4	31	13.1	4.4
Grafton, Ill	1,306	23	20.0	5	13.3	31	16.6	6.7
St. Louis, Mo	1,264	30	31.5	4–6	19.7	31	25.8	11.8
Chester, Ill	1,189	30	27.4	1,7	17.6	31	22.5	9.8
New Madrid, Mo	1,003	34	28.7	1	19.2	31	23.8	9.5
Memphis, Tenn	843	33	28.2	1	17.4	31	22.9	10.8
Helena, Ark	767	42	37.0	1	22.2	31	30.0	14.8
Arkansas City, Ark	635	42	45.5	1	25.9	31	36.7	19.6
Greenville, Miss	595	42	39.6	1	21.3	31	31.2	18.3
Vicksburg, Miss	474	45	45.7	1	25.6	31	38 0	20.1
Natchez, Miss	373	46	47.3	1	30.5	31	41.6	16.8
Baton Rouge, La	240	35	39.0	1	26.0	31	34.8	13.0
Donaldsonville, La	188	28	30.9	1	20.0	31	27.4	10.9
New Orleans, La	108	18	19.5	1,2	13.2	31	17.5	6.3
Atchafalaya River.								
Simmesport, La	127	41	44.7	1,2	31.9	31	40.7	12.8
Melville, La	103	37	39.3	1,2	31.5	31	36.8	7.8
Hudson River.								
Troy, N. Y	154	14	4.6	24	3.7	15	4.2	0.9
Albany, N. Y	147	12	4.7	18	0.6	9	2.9	4.1
Delaware River.								
Hancock (E. Branch), N. Y	287	12	3.9	23	2.6	13-19,21-24	2.9	1.3
Hancock (W. Branch), N. Y	287	10	3.3	3,4,26	2.5	{2,15,21,{ {23,24 {	2.8	0.8
Port Jervis, N. Y	215	14	1.6	26	— 0.6	19,23,24	—0.1	2.2
Phillipsburg, N. J	146	26	3.3	26	0.3	18	1.0	3.0
Trenton, N. J	92	18	2.1	28	0.8	18-23	1.1	1.3
North Branch Susquehanna.								
Binghamton, N. Y	183	14	3.6	25	1.8	{ 12-14,{ {18-21,23 {	2.0	1.8
Wilkes-Barre, Pa	60	17	5.7	27	2.7	20-22	3.2	3.0
West Branch Susquehanna.								
Williamsport, Pa	39	20	2.5	25	0.4	19	1.1	2.1
Susquehanna River.								
Harrisburg, Pa	69	17	3.1	26	1.0	21	1.7	2.1
Shenandoah River.								
Riverton, Va	58	22	0.9	27,28	— 1.2	19-25	—0.7	2.1
Potomac River.								
Cumberland, Md	290	8	3.8	28-31	1.9	8-24	2.3	1.9
Harpers Ferry, W. Va	172	18	3.8	29	— 0.2	21,22	1.0	4.0
James River.								
Lynchburg, Va	260	20	2.4	26	0.8	23,24	1.4	1.6
Columbia, Va	167	18	7.4	28	3.5	20,21	5.1	3.9
Richmond, Va	111	10	1.8	28	— 0.1	19,21,22	0.7	1.9
Dan River.								
Danville, Va	55	8	1.3	29	0.0	1,2,24,27	0.5	1.3
Roanoke River.								
Clarksville, Va	196	12	2.2	7	0.2	22,23	0.9	2.0
Weldon, N. C	129	30	13.0	8,31	10.1	22	11.1	2.9
Tar River.								
Greenville, N. C	21	22	8.8	31	3.3	27	4.9	5.5
Deep River.								
Moncure, N. C	171	25	8.7	7	7.3	1	7.9	1.4
Cape Fear River.								
Fayetteville, N. C	112	38	14.4	31	3.0	19	5.9	11.4
Pedee River.								
Cheraw, S. C	149	27	19.1	6	2.5	3,22	6.4	16.6
Smiths Mills, S. C	51	16	12.2	15,16	4.2	25	8.3	8.0
Lynch Creek.								
Effingham, S. C	35	12	7.5	12	3.1	24	4.5	4.4
Black River.								
Kingstree, S. C	45	12	6.4	2	0.0	30	3.4	6.4
Catawba-Wateree River.								
Mount Holly, N. C	143	15	7.0	5	1.8	1,21	2.5	5.2
Catawba, S. C	107	11	10.8	6	2.6	1	4.8	8.2
Camden, S. C	37	24	22.5	6	5.3	20	10.1	17.2
Congaree River.								
Columbia, S. C	52	15	8.2	6	0.9	14	2.5	7.3
Santee River.								
Ferguson, S. C†	82	12	13.3	14	7.7	24	11.5	5.6
Savannah River.								
Calhoun Falls, S. C	347	15	7.1	5	2.4	31	3.2	4.7
Augusta, Ga	268	32	18.0	6	7.6	25,30	9.9	10.4
Oconee River.								
Dublin, Ga	79	30	6.4	12	0.2	28–31	2.3	6.2
Ocmulgee River.								
Macon, Ga	134	18	8.9	10	2.4	27	4.5	6.5
Abbeville, Ga	51	11	7.9	14	2.6	30	4.6	5.3
Flint River.								
Montezuma, Ga	152	20	8.2	12	3.1	2	4.8	5.1
Albany, Ga	99	20	5.4	12,13	1.9	4,5	3.4	3.5
Bainbridge, Ga	22	22	9.0	14,15	6.3	4	7.7	2.7
Chattahoochee River.								
West Point, Ga	174	20	4.7	7	2.3	29	3.1	2.4
Eufaula, Ala	90	40	8.5	8,9	2.0	31	4.1	6.5
Alaga, Ala	30	25	10.0	9	4.4	31	6.1	5.6
Coosa River.								
Rome, Ga	266	30	5.6	7	1.2	23–30	2.1	4.4
Gadsden, Ala	162	22	5.6	8	1.1	29,30	2.2	4.5
Lock No. 4, Ala	118	17	4.4	9	0.8	25,30,31	1.6	3.6
Wetumpka, Ala	12	45	8.4	10	3.0	3,25,26,31	4.3	5.4
Alabama River.								
Montgomery, Ala	323	35	5.4	10	1.6	26	2.6	3.8
Selma, Ala	246	35	6.3	11	2.0	4,21	3.2	4.3
Black Warrior River.								
Tuscaloosa, Ala	90	43	10.5	10	5.3	3,17,18	6.7	5.2
Tombigbee River.								
Columbus, Miss	316	33	0.7	11	— 2.3	18,20	—1.2	3.0
Demopolis, Ala	168	35	7.3	12	1.0	19	3.4	6.3
Pascagoula River.								
Merrill, Miss	78	20	7.1	30	2.0	25	4.0	5.1
Pearl River.								
Columbia, Miss	110	18	8.0	10	4.0	23–26	4.9	4.0
Sabine River.								
Logansport, La	315	25	5.2	1	2.0	22,23	3.4	3.2
Neches River.								
Beaumont, Tex	18	10	1.7	8	0.6	31	1.2	1.1
Trinity River.								
Dallas, Tex	320	25	25.5	22	6.5	15	15.5	19.0
Long Lake, Tex	211	35	20.8	31	3.0	22	9.5	17.8
Liberty, Tex	20	25	26.7	1	6.5	29	12.7	20.2
Brazos River.								
Waco, Tex	285	22	6.1	25	3.0	19	3.9	3.1
Hempstead, Tex	140	40	6.5	10	2.4	6	4.3	4.1
Booth, Tex	61	39	6.7	30	5.2	23–26	5.9	1.5
Colorado River.								
Austin, Tex	214	18	5.1	11	1.8	31	2.7	3.3
Columbus, Tex	98	24	13.8	13	7.1	30,31	8.8	6.7
Red River of the North.								
Moorhead, Minn	284	26	12.7	1	10.0	25,26	11.0	2.7
Rio Grande.								
San Marcial, N. Mex	1,233	11	11.5	18	9.0	23–25	9.6	2.5
El Paso, Tex	1,030	14	12.0	23	8.1	19	9.8	3.9
Snake River.								
Lewiston, Idaho	144	24	9.9	2–4	2.2	31	6.1	7.7
Riparia, Wash	67	30	10.0	3	3.3	31	6.5	6.7
Columbia River.								
Wenatchee, Wash	473	40	35.8	1	28.5	31	32.5	6.3
Umatilla, Oreg	270	25	18.2	1	12.9	31	15.7	5.3
The Dalles, Oreg	166	40	30.5	1	20.1	31	25.5	10.4
Willamette River.								
Albany, Oreg	118	20	3.0	1–3	1.5	28–31	2.1	1.5
Portland, Oreg	12	15	18.1	1	11.0	31	14.5	7.1
Sacramento River.								
Red Bluff, Cal	265	23	1.9	1,2	0.8	30,31	1.4	1.1
Sacramento, Cal	64	25	9.7	1	6.6	30,31	7.8	3.1

* River gage washt away. Figures indicate number of days missing.

Honolulu, T. H., latitude 21° 18′ north, longitude 157° 51′ west; barometer above sea, 38 feet; gravity correction, —0.057 inch, applied. July, 1908.

Day.	Pressure, in inches.*		Air temperature, degrees Fahrenheit.				Moisture.				Wind, in miles per hour.				Precipitation, inches.		Clouds.					
							8 a. m.		8 p. m.		8 a. m.		8 p. m.				8 a. m.			8 p. m.		
	8 a. m.	8 p. m.	8 a. m.	8 p. m.	Maximum.	Minimum.	Wet.	Relative humidity.	Wet.	Relative humidity.	Direction.	Velocity.	Direction.	Velocity.	8 a. m.	8 p. m.	Amount.	Kind.	Direction, from.	Amount.	Kind.	Direction, from.
			°	°			°	%	°	%												
1	30.10	30.08	76.0	73.5	81	72	65.0	55	66.0	67	ne.	9	se.	4	0.00	0.00	9	S.-cu.	ne.	0	0	0
2	30.09	30.04	75.1	75.0	80	72	67.0	66	67.0	66	ne.	12	ne.	6	0.00	0.00	9	S.-cu.	e.	2	S.-cu.	ne.
																				2	S.	ne.
3	30.11	30.06	76.0	75.0	80	72	68.0	66	69.0	74	ne.	4	ne.	10	0.00	0.00	8	S.-cu.	e.	3	S.-cu.	ne.
																				5	S.	ne.
4	30.06	30.05	76.0	75.0	80	72	71.0	78	67.0	66	ne.	8	ne.	9	0.01	0.00	8	S.-cu.	ne.	7	S.	ne.
5	30.04	30.07	76.0	75.5	81	71	70.0	74	68.0	68	ne.	4	e.	5	T.	0.00	9	S.-cu.	ne.	8	Cu.	ne.
6	30.10	30.10	76.0	73.5	80	72	66.0	59	68.0	76	ne.	9	ne.	3	0.00	T.	9	S.-cu.	e.	8	S.	ne.
7	30.10	30.05	75.0	69.0	79	69	66.0	62	68.0	95	ne.	8	ne.	6	0.00	0.02	9	S.-cu.	ne.	10	N.	ne.
8	30.04	30.03	73.0	74.0	80	68	66.1	70	67.0	69	ne.	8	ne.	6	0.07	0.00	6	A.-cu.	e.	1	Cu.	ne.
																	2	Cu.	e.			
9	30.07	30.06	77.2	75.0	82	72	68.1	63	68.0	70	e.	13	e.	9	0.00	0.00	3	Ci.-s.	0 ?	1	A.-s.	nw.
																	4	Cu.	e.	1	S.	ne.
10	30.06	30.04	77.0	75.0	80	73	69.0	67	68.0	70	e.	6	s.	3	0.00	0.00	4	Ci.-s.	w.	10	S.	ne.
																	5	S.-cu.	ne.			
11	30.06	30.02	77.0	75.0	81	72	66.0	56	67.0	66	ne.	12	ne.	5	0.00	0.00	7	Ci.	w.	1	S.-cu	ne.
																	2	Cu.	ne.			
12	30.04	30.03	75.0	76.0	81	72	67.4	68	68.0	66	ne.	10	e.	9	0.00	0.00	9	S.-cu.	e.	Few	Ci.	0 ?
																				1	Cu.	ne.
13	30.03	30.01	77.0	75.5	82	74	67.2	60	68.0	68	ne.	9	e.	17	0.00	0.00	1	Ci.-s.	0 ?	3	A.-cu.	s.
																	5	S.-cu.	e.	4	Cu.-n.	ne.
14	30.02	30.03	78.0	77.0	82	74	67.0	56	69.0	67	e.	10	e.	6	0.00	0.00	1	A.-s.	0 ?	10	S.	ne.
																	Few	Cu.	e.			
15	30.04	30.04	79.2	75.5	81	74	70.0	73	69.0	72	e.	8	e.	4	0.00	0.00	2	Ci.	nw.	7	S.	e.
																	2	Cu.	ne.			
16	30.08	30.07	76.0	75.0	82	74	67.0	62	67.0	66	e.	10	e.	3	0.00	0.00	9	S.-cu.	e.	1	S.	ne.
17	30.07	30.08	76.0	76.0	81	73	65.6	57	65.5	57	ne.	16	e.	12	0.00	0.00	1	A -cu.	0	2	Cu.	ne.
																	8	S.-cu.	e.			
18	30.10	30.06	75.0	75.0	79	69	67.0	66	67.0	66	ne.	11	ne.	5	0.01	0.00	7	Cu.	e.	1	A.-s.	w.
19	30.05	30.01	73.9	74.0	80	70	67.0	69	66.0	65	e.	8	ne.	8	0.00	T.	7	Cu.	ne.	0	0	0
20	30.04	30.04	75.0	74.0	81	71	66.1	62	67.0	69	e.	8	e.	4	0.00	0.00	8	S.-cu.	e.	0	0	0
21	30.08	30.07	78.0	75.0	82	71	68.0	60	69.0	74	ne.	5	ne.	16	0.00	0.00	Few	A.-s.	0	0	0	0
																	1	Cu.	ne.			
22	30.11	30.08	80.0	76.0	84	72	70.1	61	69.0	70	e.	4	e.	8	0.00	0.00	4	Cu.	e.	1	A.-s.	0 ?
																				3	S.	ne.
23	30.09	30.05	77.4	75.0	82	74	68.0	62	68.0	70	e.	9	e.	4	0.00	0.00	Few	A.-cu.	0	5	S.	ne.
																	7	Cu.	e.			
24	30.08	30.05	76.1	75.0	81	72	67.4	63	66.0	62	e.	3	e.	10	T.	0.00	8	S.-cu.	n.	1	A.-s.	nw.
																				2	S.	e.
25	30.05	30.02	77.0	75.0	81	71	67.1	59	68.0	70	ne.	14	e.	10	0.02	T.	2	Ci.-s.	w.	1	A.-s.	0 ?
																	2	Cu.	e.	5	S.	e.
26	30.04	30.02	77.0	74.0	81	70	65.5	54	68.0	74	e.	13	e.	8	0.03	0.00	Few	Cu.	e.	2	A.-s.	w.
																				2	Cu.	ne.
27	30.04	30.02	79.0	76.0	81	73	70.0	64	69.0	70	ne.	6	ne.	5	0.00	0.00	3	Ci.-s.	sw.	2	A.-s.	s.
																	2	Cu.	e.	4	S.	e.
28	30.03	29.98	76.0	76.0	82	72	69.6	72	68.0	66	ne.	8	ne.	10	0.00	0.00	9	S.-cu.	e.	2	A.-s.	sw.
																				5	S.	e.
29	29.99	29.95	77.9	75.5	82	71	68.3	62	68.0	68	e.	3	ne.	6	0.00	0.00	6	Cu.	e.	2	A.-s.	nw.
																				1	Cu.-n.	e.
30	30.00	30.01	77.0	76 0	81	73	68.0	63	69.0	70	e.	7	ne.	10	T.	0.00	2	Cu.	ne.	3	A.-s.	nw.
31	30.00	30.05	78.0	76.0	81	72	68.0	60	69.0	70	ne.	7	e.	12	0.00	T.	Few	Cu.	e.	7	S.	ne.
Mean	30.060	30.041	76.5	74.9	81.0	71.8	67.6	63.5	67.8	69.3	ne.	8.5	e.	7.5	0.14	0.02	6.5	Cu.	e.	4.4	S.	ne.

Observations are made at 8 a. m. and 8 p. m., local standard time, which is that of 157° 30′ west, and is 5h and 30m slower than 75th meridian time. *Pressure values are reduced to sea level and standard gravity.

RAINFALL IN JAMAICA.

Thru the kindness of Mr. Maxwell Hall, meteorologist to the government of Jamaica and now in charge of the meteorological service of that island, we have received the following data:

Comparative table of rainfall.

[Based upon the average stations only.]

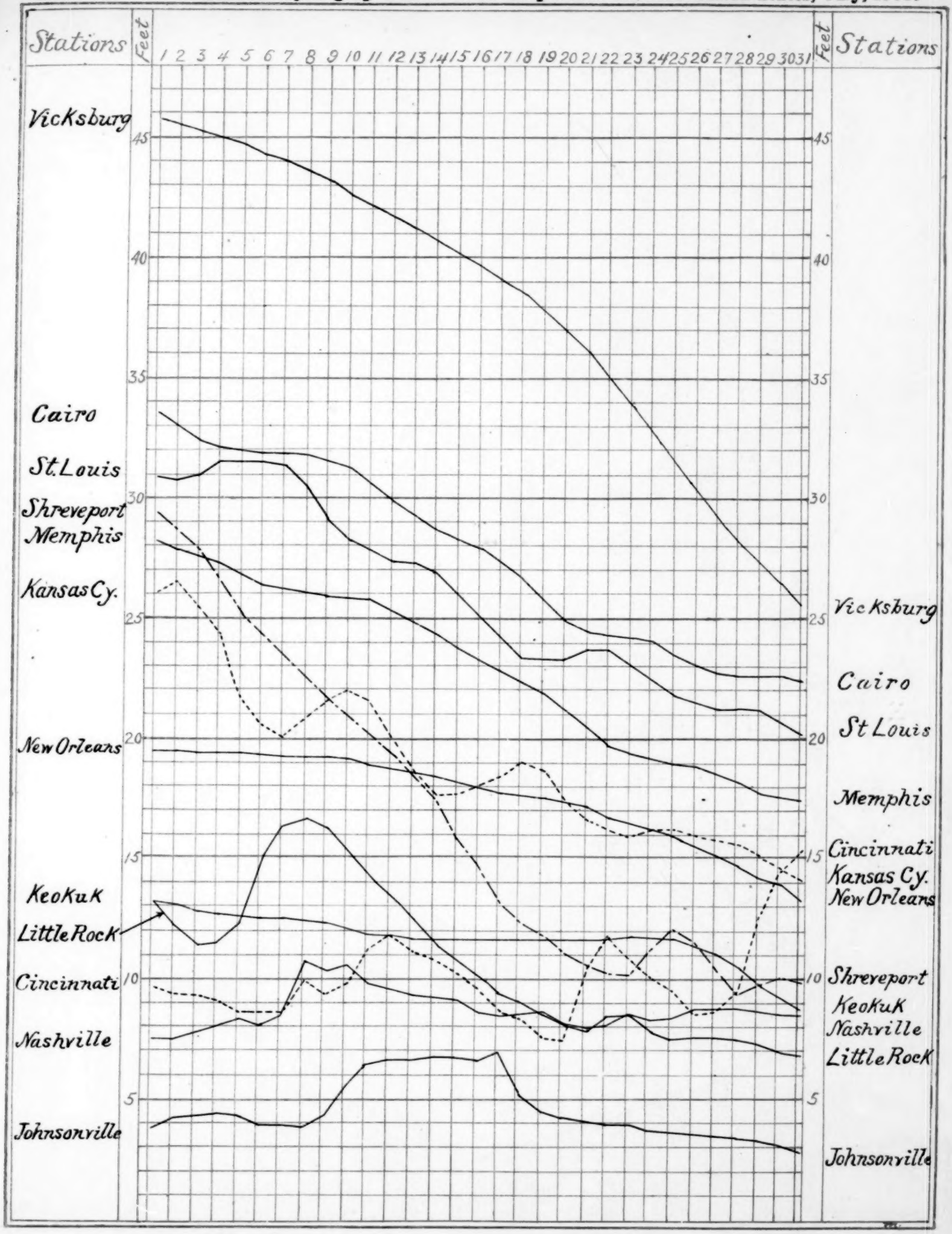
JULY, 1908.

Divisions.	Relative area.	Number of stations.	Rainfall.	
			1908.	Average.
	Per cent.		*Inches.*	*Inches.*
Northeastern division	25	21	4.03	6.55
Northern division	22	49	1.77	3.04
West-central division	26	19	7.90	8.08
Southern division	27	30	3.00	4.41
Means	100	....	4.17	.52

The rainfall over the island for July, 1908, was below the average; therefore the forecast was verified. The greatest fall was 15.40 inches at Dailiston and Belleisle, in the west-central division; no rain fell at Success, in the northern division, and at three or four other stations practically nil was recorded.

At Georgetown, Grand Cayman, June, 1908, total fall, 2.64 inches, on 12 days; greatest fall, 0.61 inch, on June 24; July, 1908, total fall, 1.81 inch, on 9 days; greatest fall, 0.60 inch, on July 15.

Chart I. Hydrographs for Seven Principal Rivers of the United States, July, 1908.



• Barkerville

Chart II. Tracks of Centers of High Areas, July, 1908.

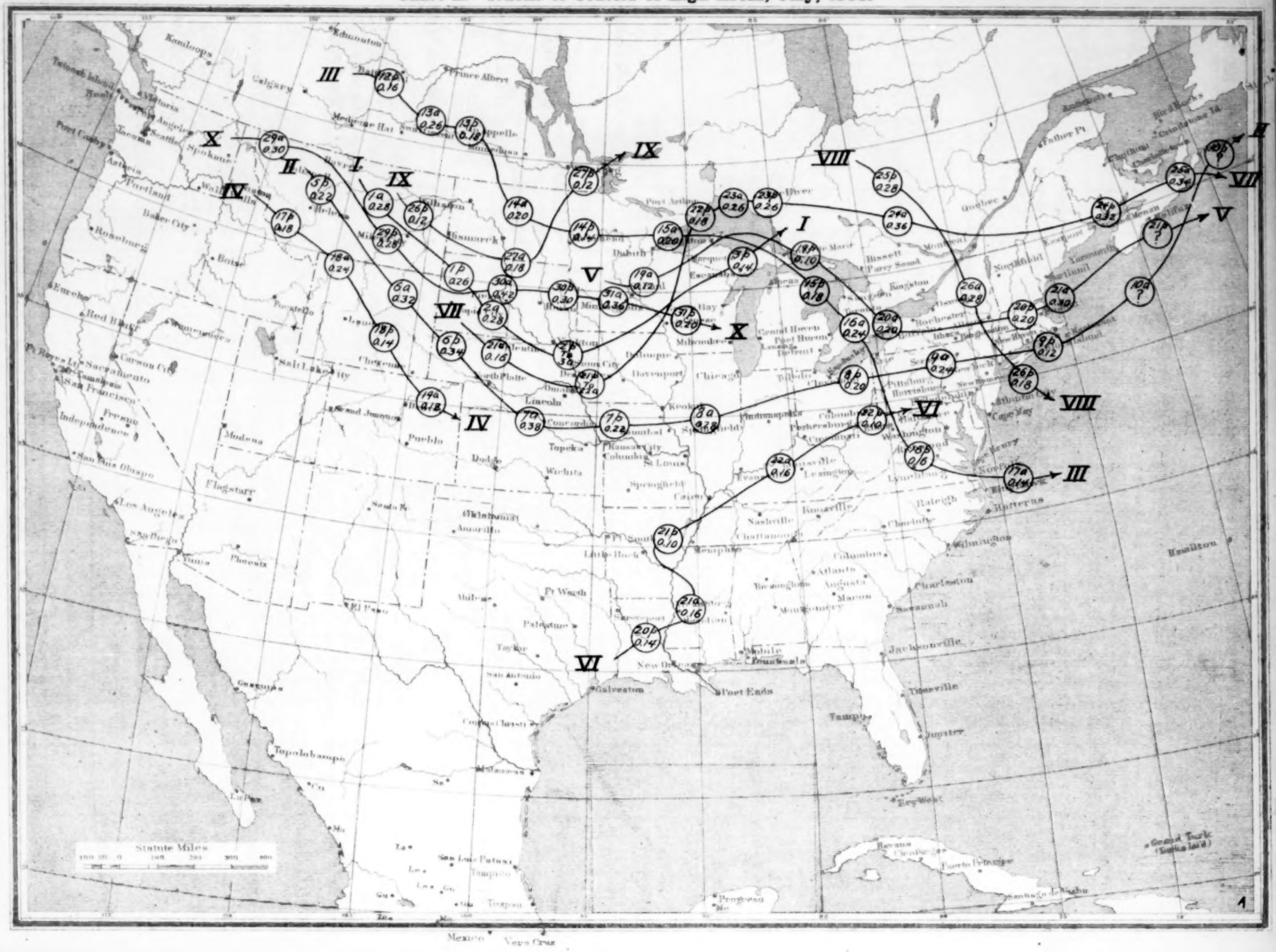


Chart III. Tracks of Centers of Low Areas, July, 1908.

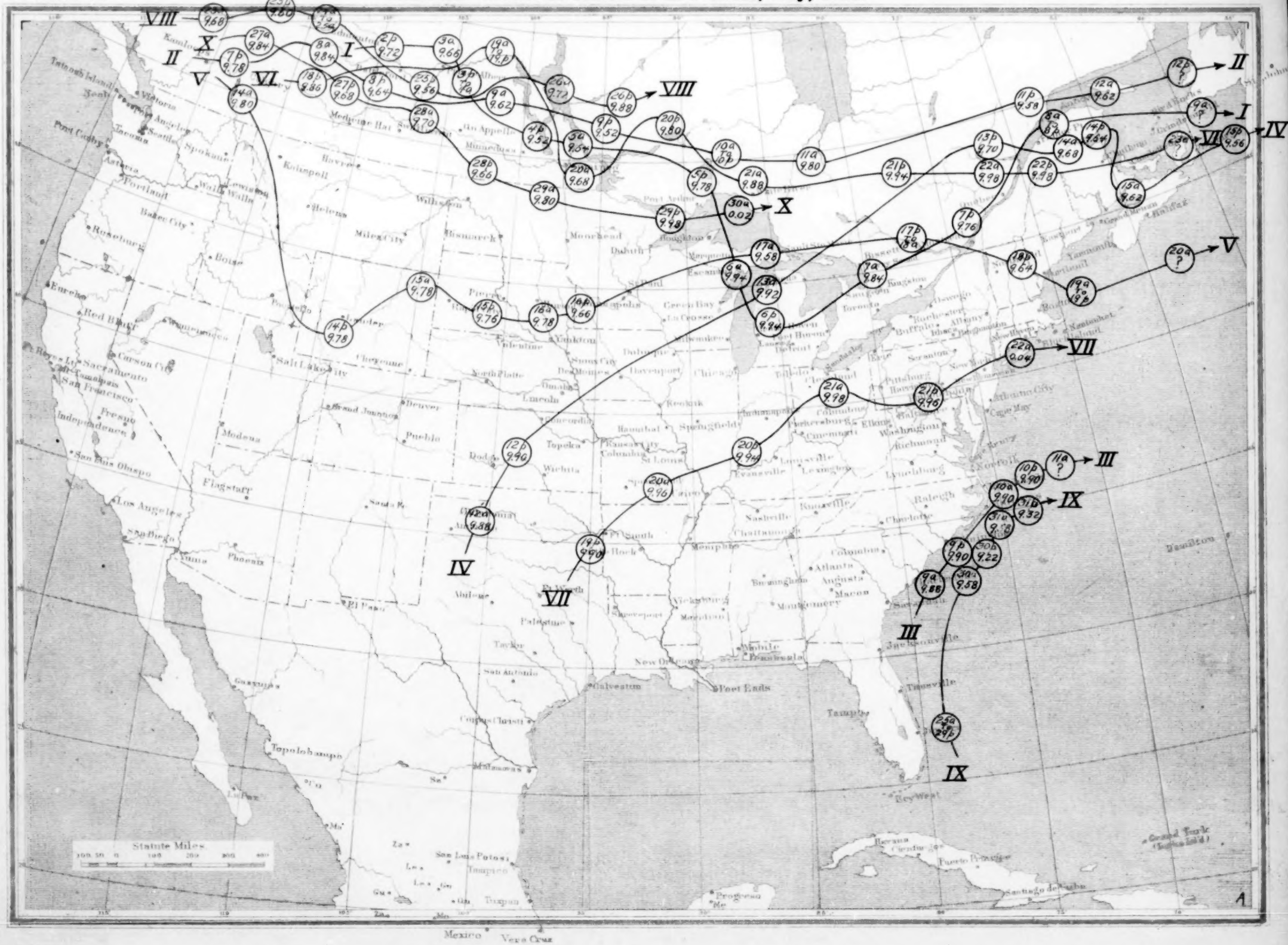


Chart IV. Total Precipitation, July, 1908.

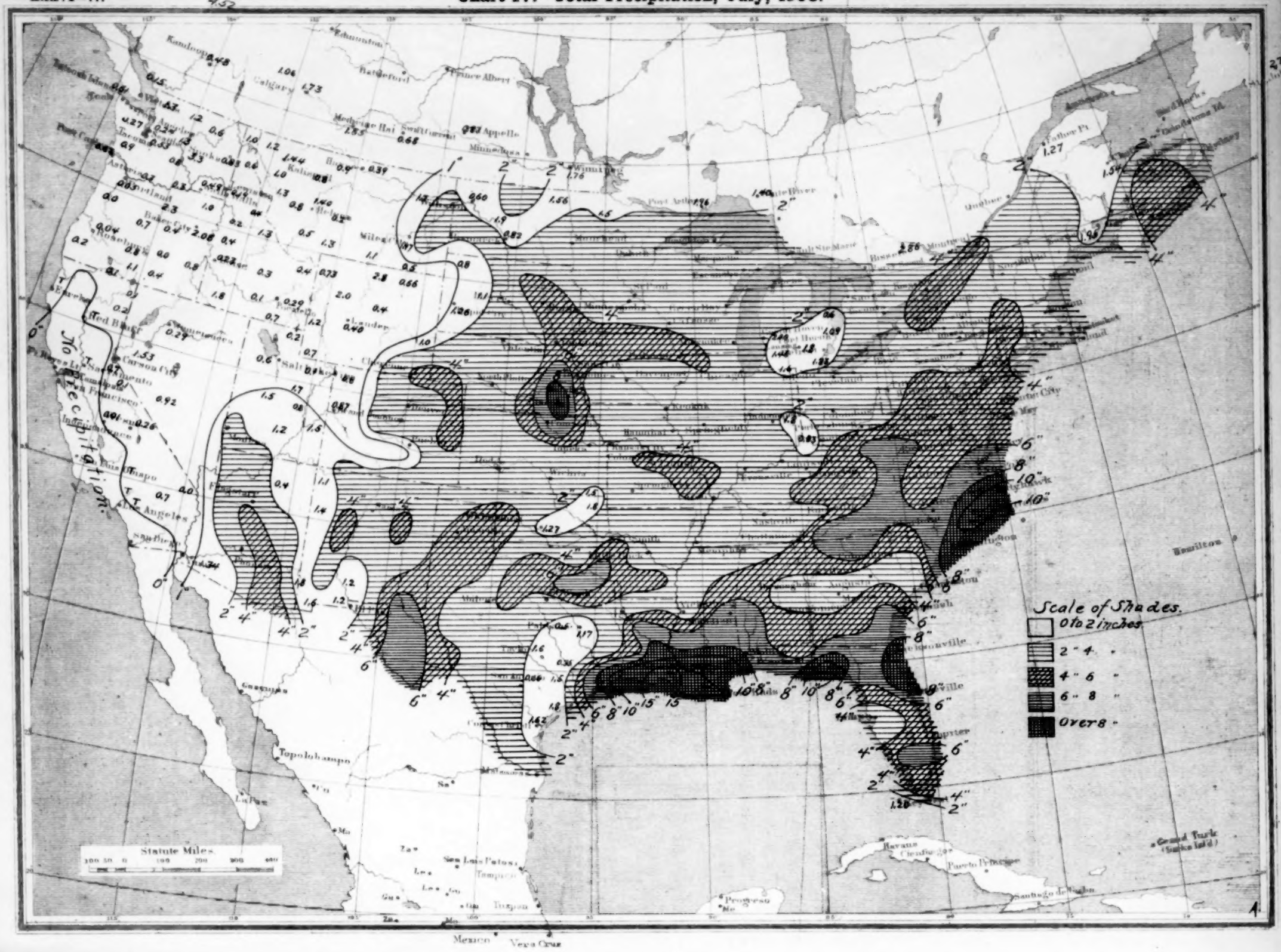


Chart V. Percentage of Clear Sky between Sunrise and Sunset, July, 1908.

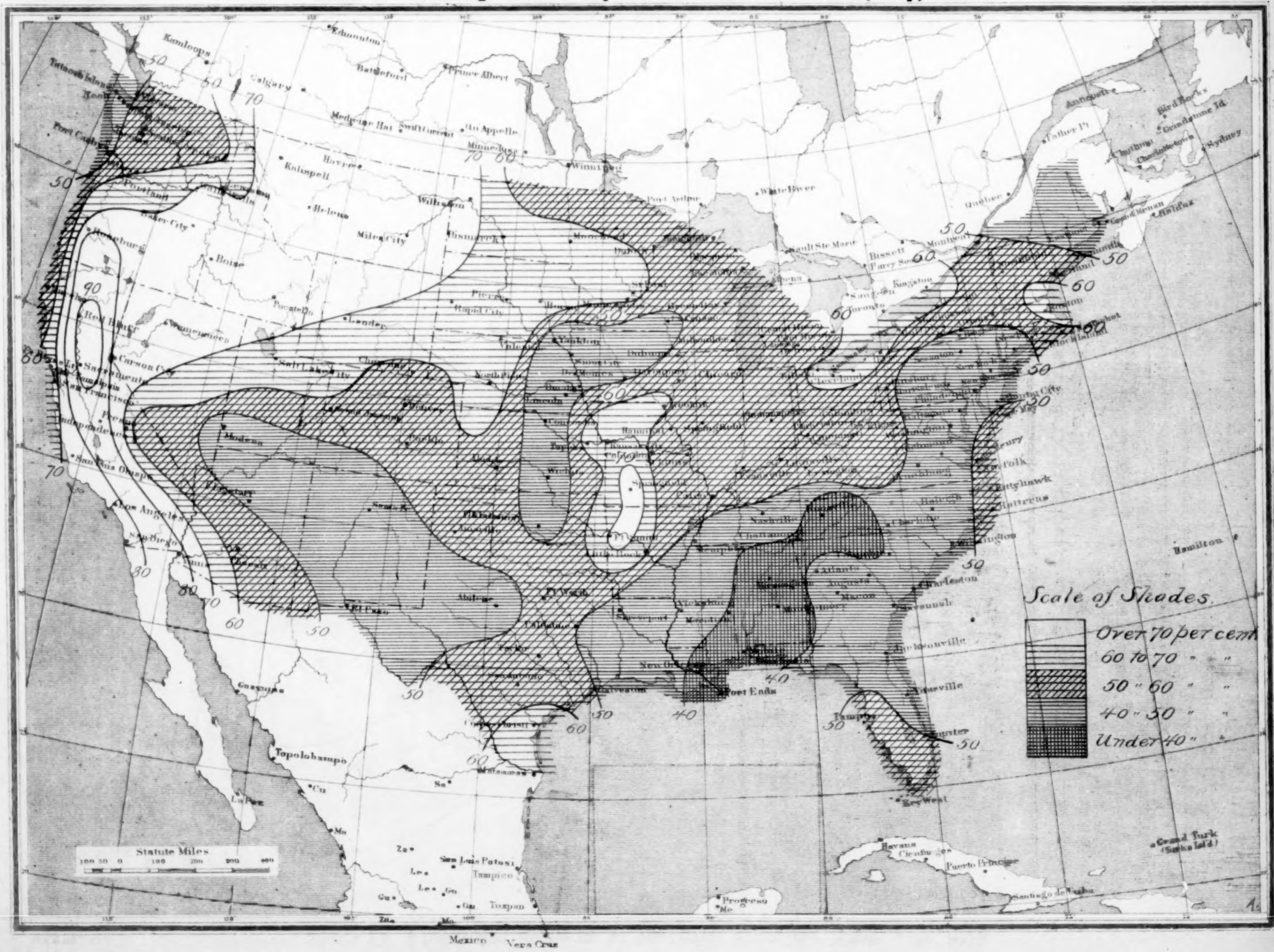
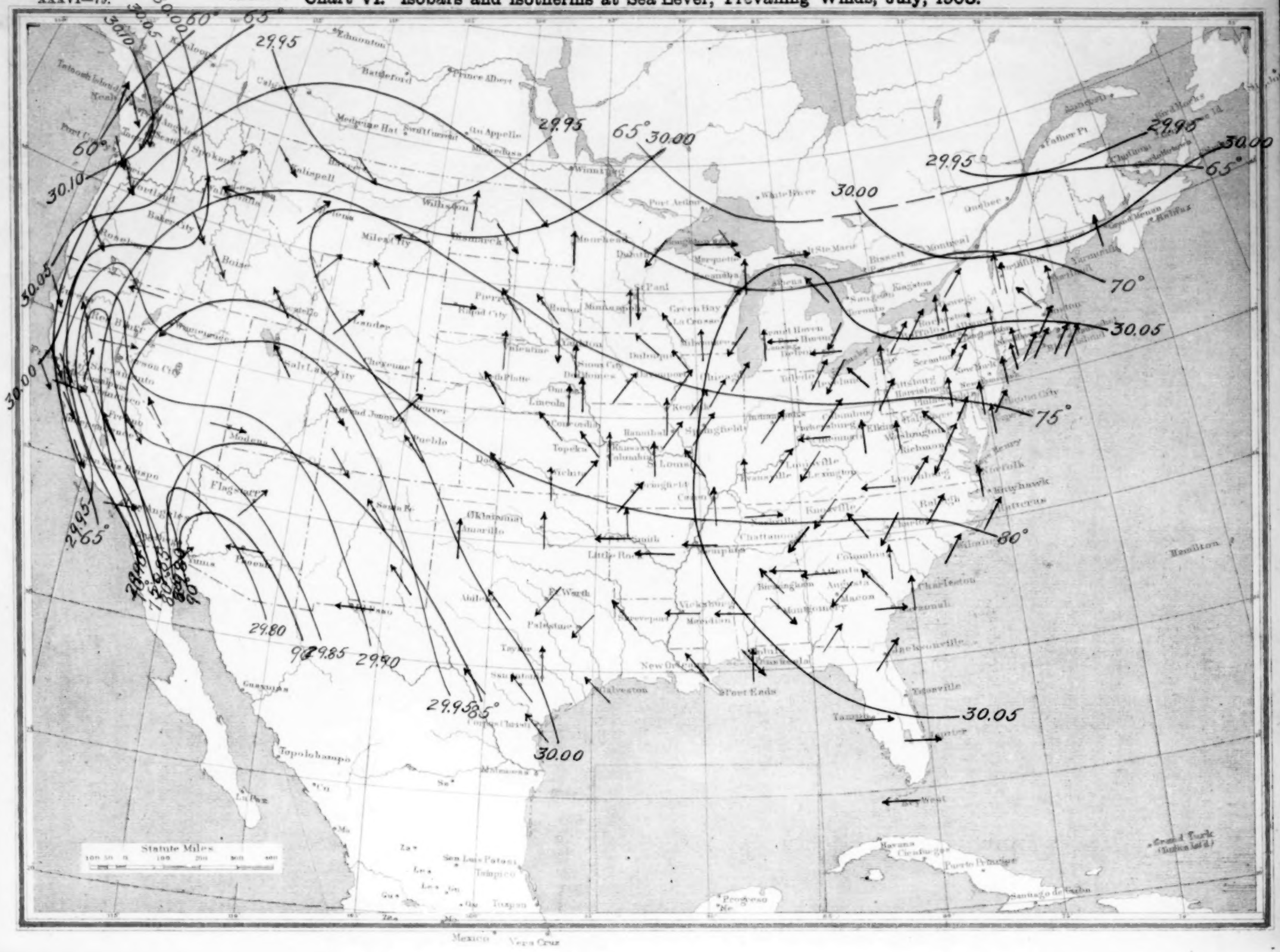



Chart VI. Isobars and Isotherms at Sea Level; Prevailing Winds, July, 1908.